

HOW TO USE THE MICROCARD

Trouble-shooting instructions:

System: Electronically controlled diesel fuel injection.

Special features: Electronically controlled exhaust-gas recirculation and road-speed control

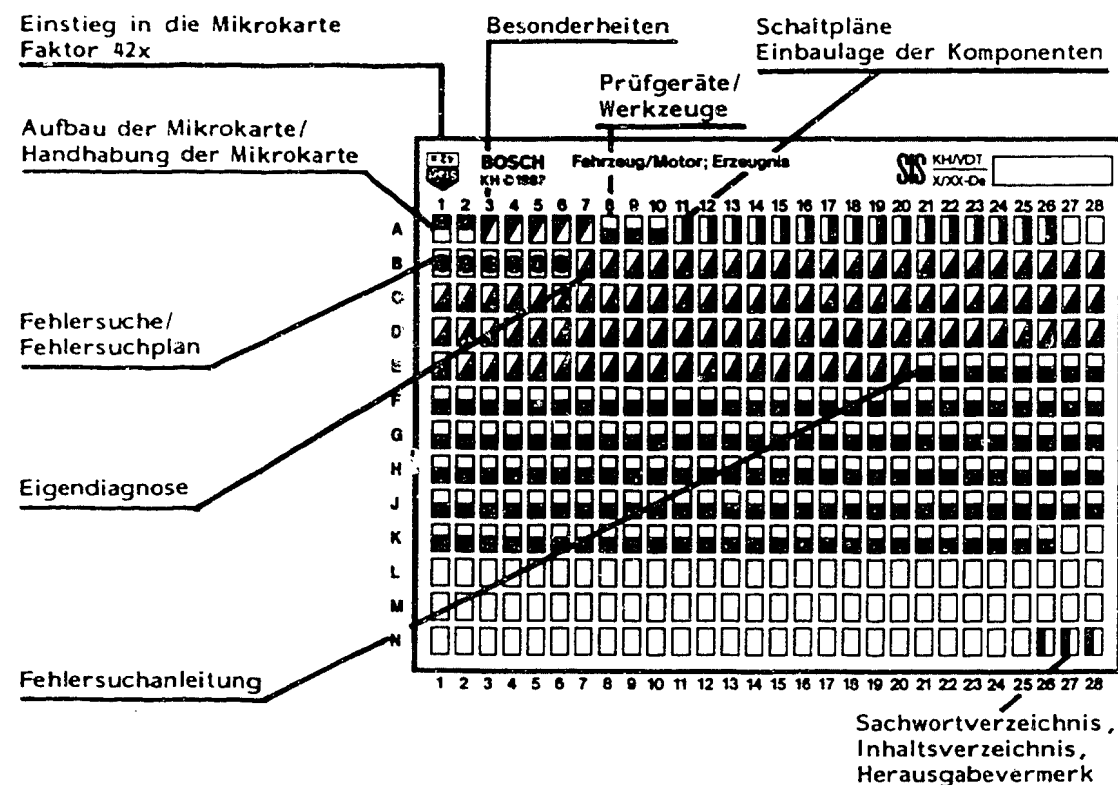
Vehicle: Peugeot 505 Turbo Diesel
Year of manufac: 03.1987
Engine: XD3T 2.5 l,
kW: 70, bhp: 95

The basic instructions are detailed trouble-shooting instructions. They must not be used as vehicle-specific instructions.

ATTENTION!

Descriptions and photos may deviate from the vehicle-specific brief instructions; take binding test specifications, terminal assignments and special features only from the vehicle-specific brief instructions.

For brief instructions, see microcard KFZ-00..



LAYOUT OF THIS MICROCARD

1. Read from left to right.
2. Title of microfiche (appears on each coordinate).

E16	Product/component/test step	
	Coordinate	

3. Limits of section

\Rightarrow	\Leftarrow	\Leftarrow	\Rightarrow \Leftarrow
Beginning	Mid-section	End	One-page Section

A01		\Rightarrow \Leftarrow
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A02		\Rightarrow \Leftarrow
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SPECIAL FEATURES

The electronically controlled diesel fuel injection (EDC = Electronic Diesel Control) comprises a distributor-type fuel-injection pump with integral solenoid actuator for control of the injected fuel quantity instead of a mechanical centrifugal governor, and a solenoid-operated valve for start-of-injection control.

The distributor-type fuel-injection pump is actuated by two control units using micro-processor techniques. These control units process information obtained from peripheral sensors about:

- * Air, water and fuel temperature
- * Engine speed
- * Start of injection
- * Atmospheric pressure
- * Road speed
- * Air quantity.

For monitoring purposes, the EDC system is equipped with a self-diagnosis facility and a safety and limp-home program.

Depending upon the fault present, this program triggers either immediate shutoff of the engine, or allows further running of the vehicle, however, under limited conditions.

Defective EDC-specific components are determined by flashing codes assigned specifically to individual components.

* Breakdown of the self-diagnosis (Flashing code)

- 1.1 Program end code
- 1.2 Program start code
- 1.3 Temperature sensor, intake air
- 1.4 Temperature sensor, coolant
- 1.5 Temperature sensor, fuel
- 2.1 Accelerator pedal
- 2.2 Rotational-angle potentiometer
- 2.3 Delivery controller
- 2.4 Road-speed sensor
- 2.5 Pressure transducer, road-speed control
- 3.1 Atmospheric-pressure sensor
- 3.3 Air-flow sensor
- 3.4 Pressure transducer, exhaust-gas-recirc. control
- 4.1 Engine-speed sensor
- 4.2 Needle-movement sensor
- 4.3 Solenoid-operated-valve start of injection
- 5.1 Computer interface, control unit (stored fault)
- 5.2 Computer interface, control unit (current fault) and computer monitoring - control unit 1

Steady light (flashing code cannot be called up)
Computer monitoring - control unit 2

N o t e :

If the voltage supply for the control units is interrupted, the faults stored in the self-diagnosis are c l e a r e d .

* Safety and limp-home program

Faults / Limp-home measure

1. Delivery controller defective:
Engine is shutoff via ELAB
2. Timing device defective:
Fuel delivery is limited.
3. Air-flow sensor defective:
Fixed value for air quantity, no exhaust-gas recirculation.
4. Exhaust-gas-recirculation actuator defective:
Fuel delivery is limited, exhaust-gas recirculation switched off.
5. Accelerator pedal defective:
Engine runs at a constant speed.
(e.g. 1270 min⁻¹)
6. Engine-speed sensor defective:
Determination of a substitute engine speed from the start-of-injection signal.
Road-speed and exhaust-gas-recirculation control are switched off.
Start of injection is open-loop controlled, quantity of fuel injected is reduced, max. engine speed limited and idle speed increased.
7. Needle-movement sensor defective:
Fuel delivery is limited and start of injection open-loop controlled.
8. Road-speed sensor defective: *
Road-speed control is switched off.

Safety and limp-home program
(continued)

9. Water-temperature sensor defective: *
Control unit operates with substitute values and exhaust-gas recirculation is switched off.
10. Air-temperature sensor defective: *
Control unit operates with substitute values and exhaust-gas recirculation is switched off.
11. Fuel-temperature sensor defective: *
Control unit operates with substitute values.
12. Potentiometer actuator defective:
Engine comes to a standstill, delivery controller is switched off.
13. Road-speed-control pressure transducer defective: *
Road-speed control is switched off.
14. Charge-air-pressure/atmospheric-pressure sensor defective: *
No altitude compensation of exhaust-gas recirculation.
15. Computer interface (control unit) defective:
Full-load delivery is reduced.
Control unit operates with substitute values.
16. Computer monitoring (control unit) defective:
Control unit 1 defective:
Delivery controller is switched off.
Control unit 2 defective:
Solenoid-operated-valve start of injection de-energized, exhaust-gas recirculation is switched off.

N o t e :

* = Slight fault, indicator lamp of self-diagnosis goes out 30 seconds after the engine starts.

SAFETY AND PRECAUTIONARY MEASURES

Always observe these measures in order to prevent damage to the engine, control units and peripheral components of the EDC.

1. For testing the compression, disconnect the 7-pin connector from the distributor-type-fuel injection pump.
2. In the case of nozzle-holder assemblies inductive start-of-injection sensor, the after-sales service workshop is permitted to perform only a correction of the nozzle-opening pressure.
3. Never start the engine if the battery is not firmly connected.
4. Do not use a fast charger for starting the engine.
Provide starting assistance only using a second 12 V battery and jumper cables.
5. Before fast charging, disconnect the battery from the vehicle electrical system.
6. Never disconnect the battery from the vehicle electrical system when the engine is running.
7. Never disconnect or connect the control-unit plug when the ignition is switched on.
8. At temperatures above + 80° C (paint-drying installation), remove the control units.
9. When welding (electric spot welding), remove the control units.

TEST EQUIPMENT AND TOOLS

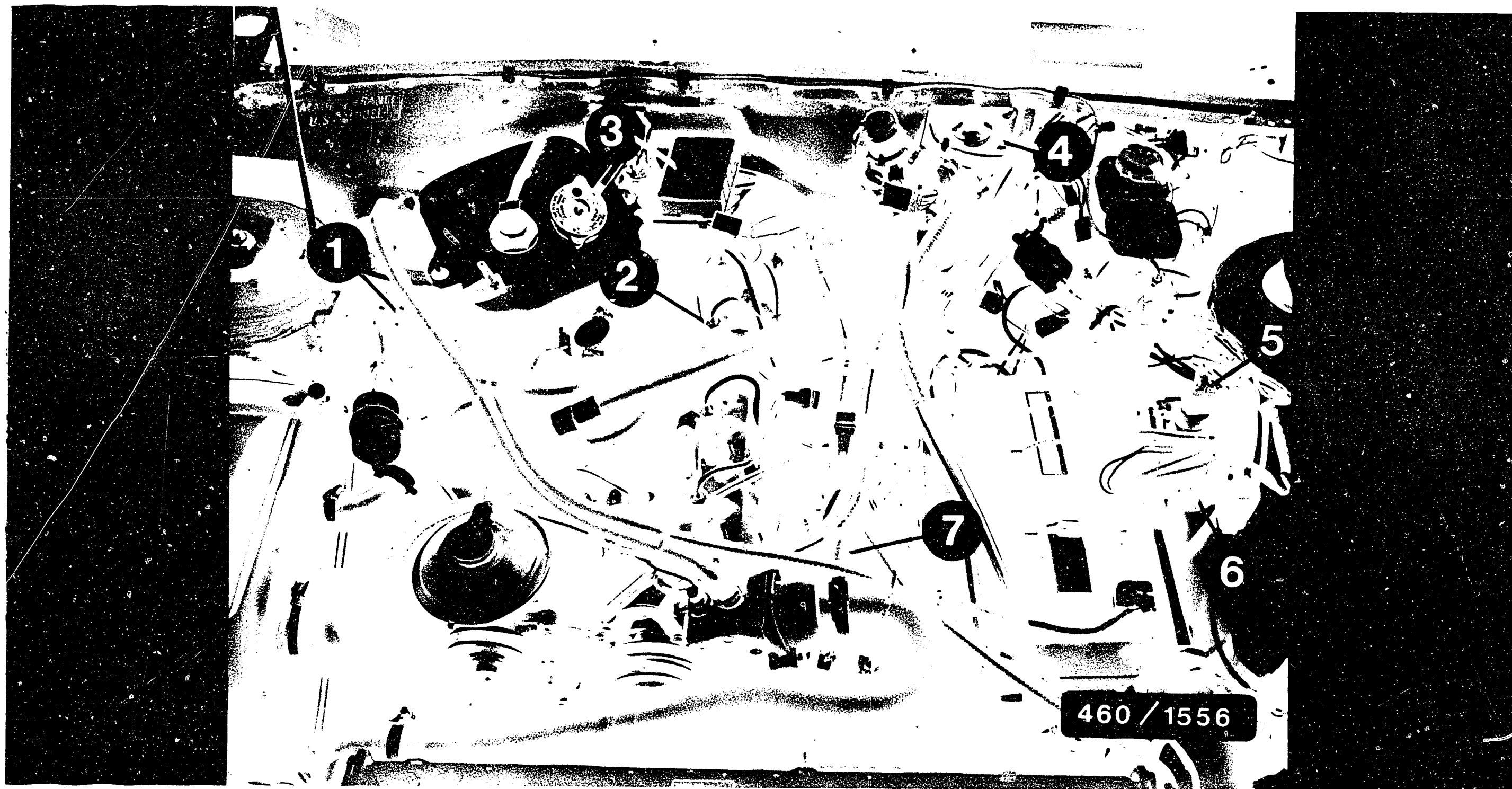
Designation	Part number	Application
Peugeot special tool	976036 on KDEP-T 1200	Removal, valve spring (engine)
Pressure tester or pressure gauge 0...1.6 bar	KDJE-P 100 e.g. Wika No. 4 184	Testing charge-air pressure
Box wrench	KDEP 1115	Loosening/tightening fuel-injection lines
Measuring tool	KDEP 2991	Coordination, pump - engine (injection timing)
Measuring tool	KDEP 1085	Coordination, pump - engine (injection timing)
Adapter for measuring tool	KDEP 1127	Coordination, pump - engine (injection timing)
Mini dial indicator division 1/100 mm	Commercially available e.g. Hahn & Kolb D-7000 Stuttgart Part no. 33 003	Coordination, pump - engine (injection timing)
Vacuum hand pump "Mityvac"	Korinth Co. Ludwig-Kloos-Straße 21 D-6450 Hanau 7 (Steinheim)	Testing EGR value and throttle-valve intake air

Test equipment and tools (continued)

Designation	Part number	Application
Nozzle tester	EFEP 60 H 0 681 200 502	Testing injection nozzles
Compression tester	Commercially available	Testing engine compression
Pressure-loss tester	EFAW 210 A 0 681 001 901	Testing engine pressure loss
Tachometer	Commercially available e.g. Dr. E. Horn GmbH Meßgerätefabrik Postfach 40 D-7036 Schönaich Order designation: HT 446 (with digital indicator)	Adjusting engine speed
Differential-pressure gauge	Commercially available Part No. NG 160/311-911 - 1.0 + 4.0 bar Haenni Co. Nauheimerstr. 78-80 D-7000 Stuttgart 50	Filter test
Evaluation unit, accessory box with sampling pump	0 684 102 050 0 681 169 038 or 0 681 169 058	Smoke test

Test equipment and tools (continued)

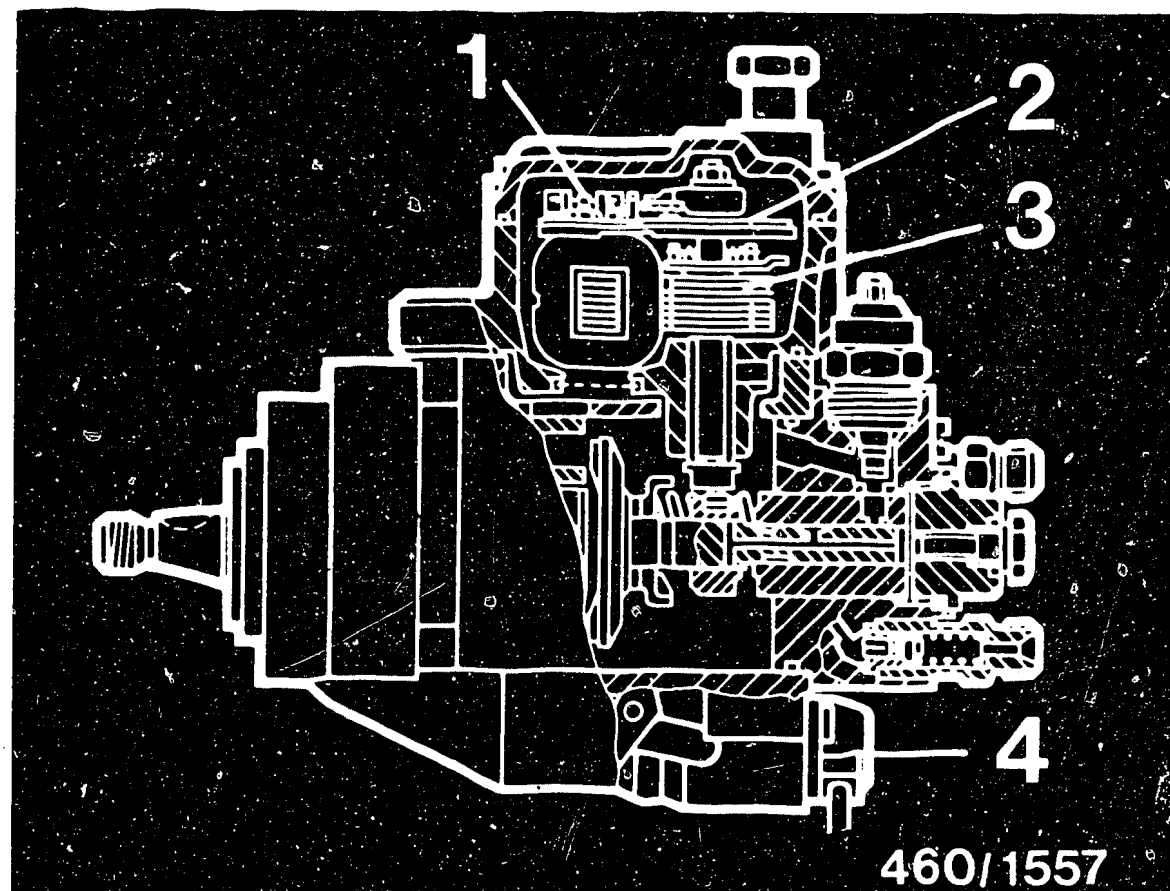
Designation	Part number	Application
Test adapter	KDEP 1160 or KDEP 1165	Testing EDC system
Adapter lead to KDEP 1165	KDEP 1165/ -200 -201	Testing EDC system
Test lead	KDZS 0004 0005	Testing EDC system
Test lead	KDUM 0007 0008	Testing EDC system
Test lead	Commercially available, double-ended pin terminal diameter 4 mm	Testing EDC system
Multimeter	Commercially available e.g. F l u k e 75 Multimeter	Testing EDC system
Motortester MOT 201 300 400	0 684 000 201 0 684 000 300 0 684 000 400	Testing EDC system
Preheating tester	ETT 011.00 0 684 101 100	Testing preheating system



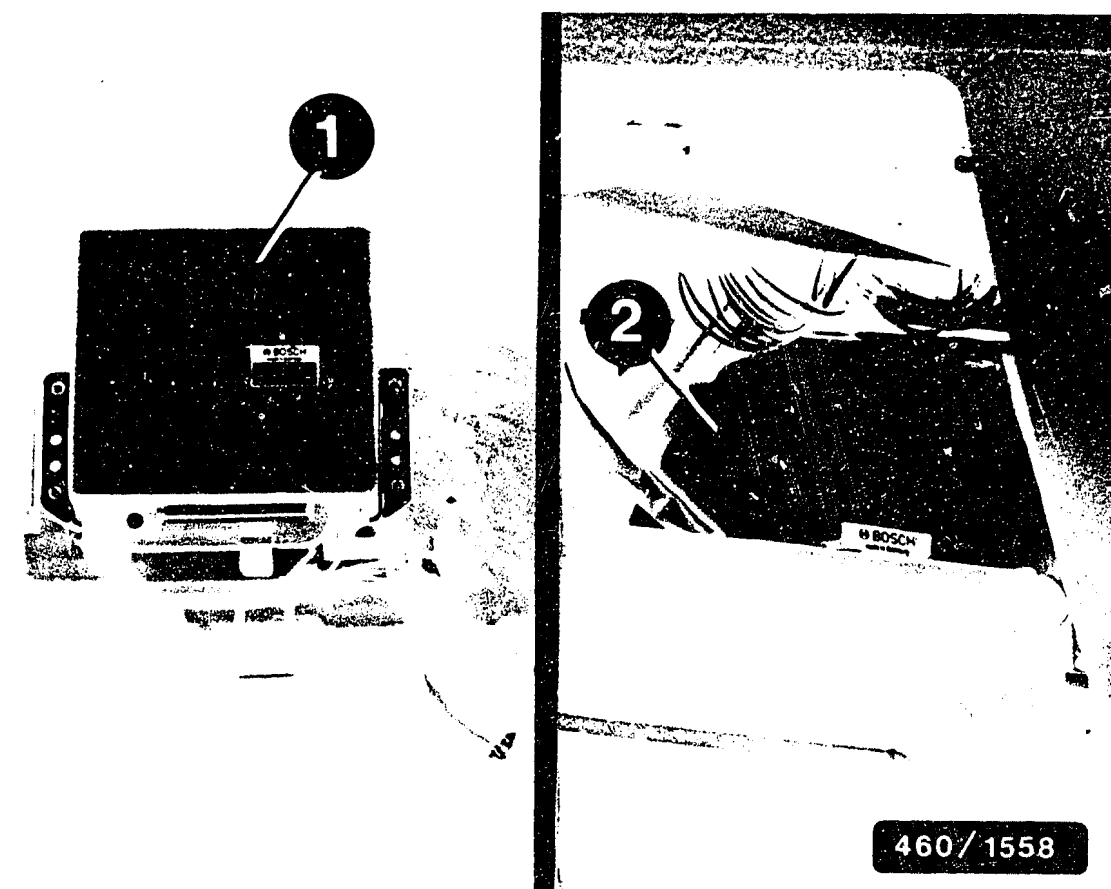
INSTALLATION POSITION OF COMPONENTS Peugeot 505 Turbo Diesel with EDC (01.1987)

- 1 = Pressure transducer, EGR
- 2 = Nozzle-holder assembly with
needle-movement sensor
- 3 = Glow-duration control unit

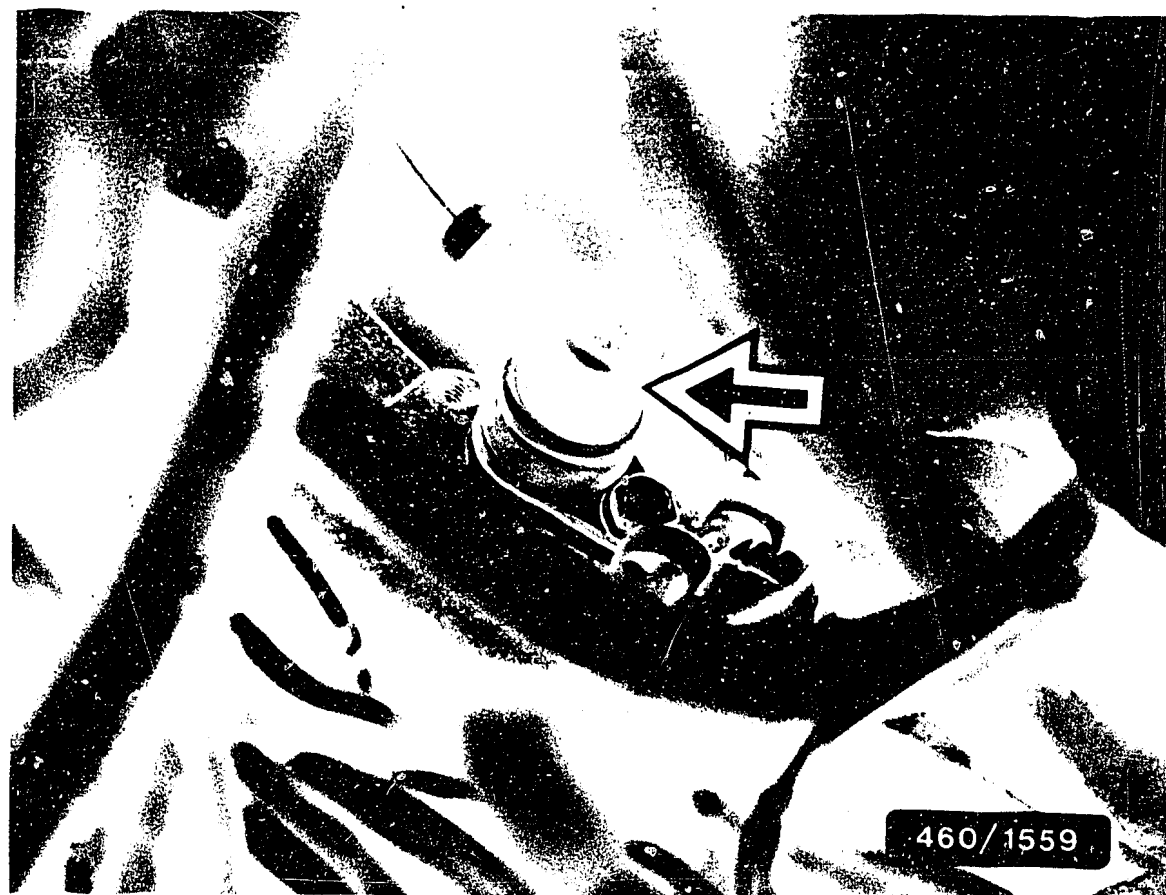
- 4 = Fuel filter
- 5 = Accelerator pedal
- 6 = Pressure transducer, speed control
(automatic vehicle only)
- 7 = Electronic fuel-injection pump



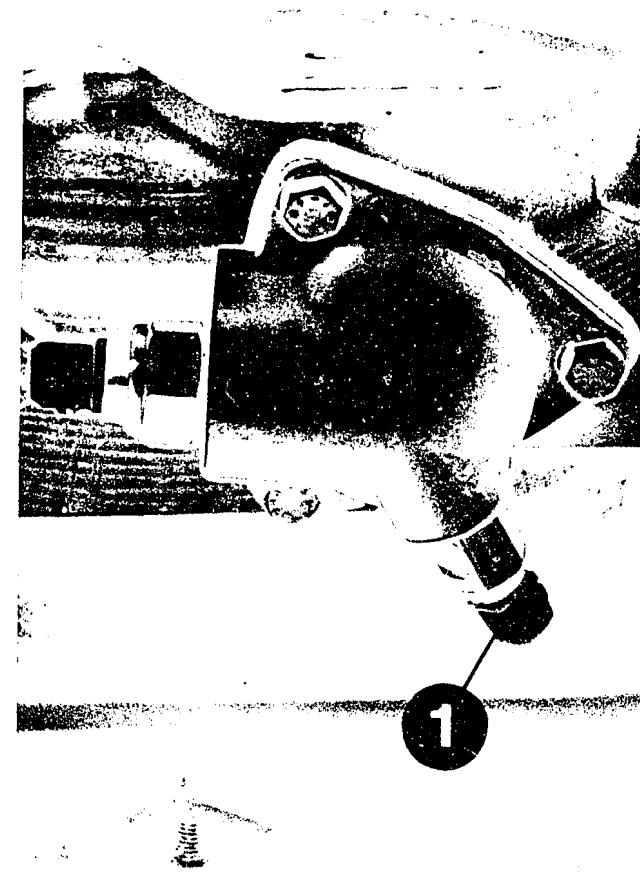
- 1 = Fuel-temperature sensor
- 2 = Rotational-angle potentiometer
- 3 = Delivery controller
- 4 = Solenoid-operated-valve start of injection



- 1 = Delivery control unit and road-speed control unit (designated control unit 1/control-unit plug 1 in the trouble-shooting instructions)
Installation position: Passenger-side footrest.
- 2 = Start-of-injection and exhaust-gas-recirculation control units
(Designated control unit 2/control-unit plug 2 in these trouble-shooting instructions)
Installation position: Behind the glove compartment.



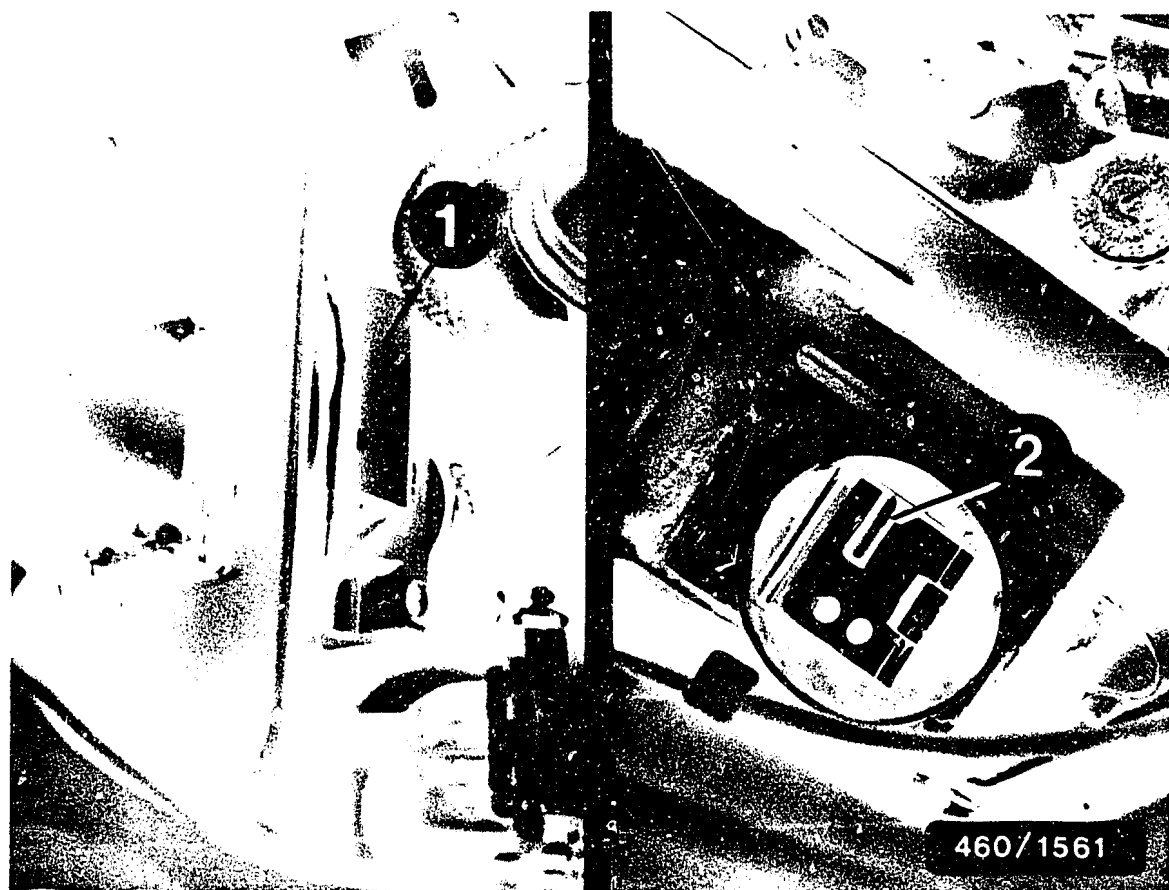
Arrow = Engine-speed sensor (on flywheel side)



1 = Coolant-temperature sensor
(On flywheel side)

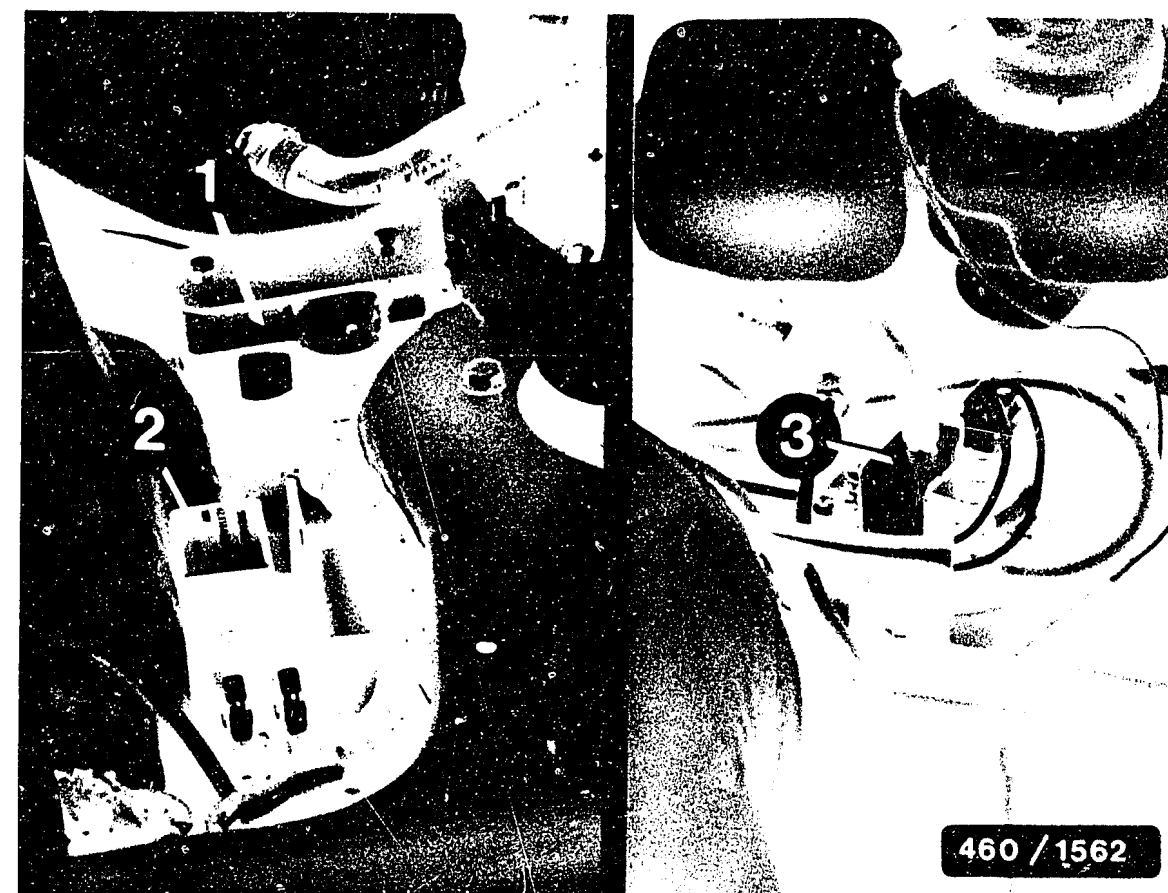


2 = Speed sensor
(Beneath the brake booster)



1 = Air-flow sensor
(Beneath the air filter)

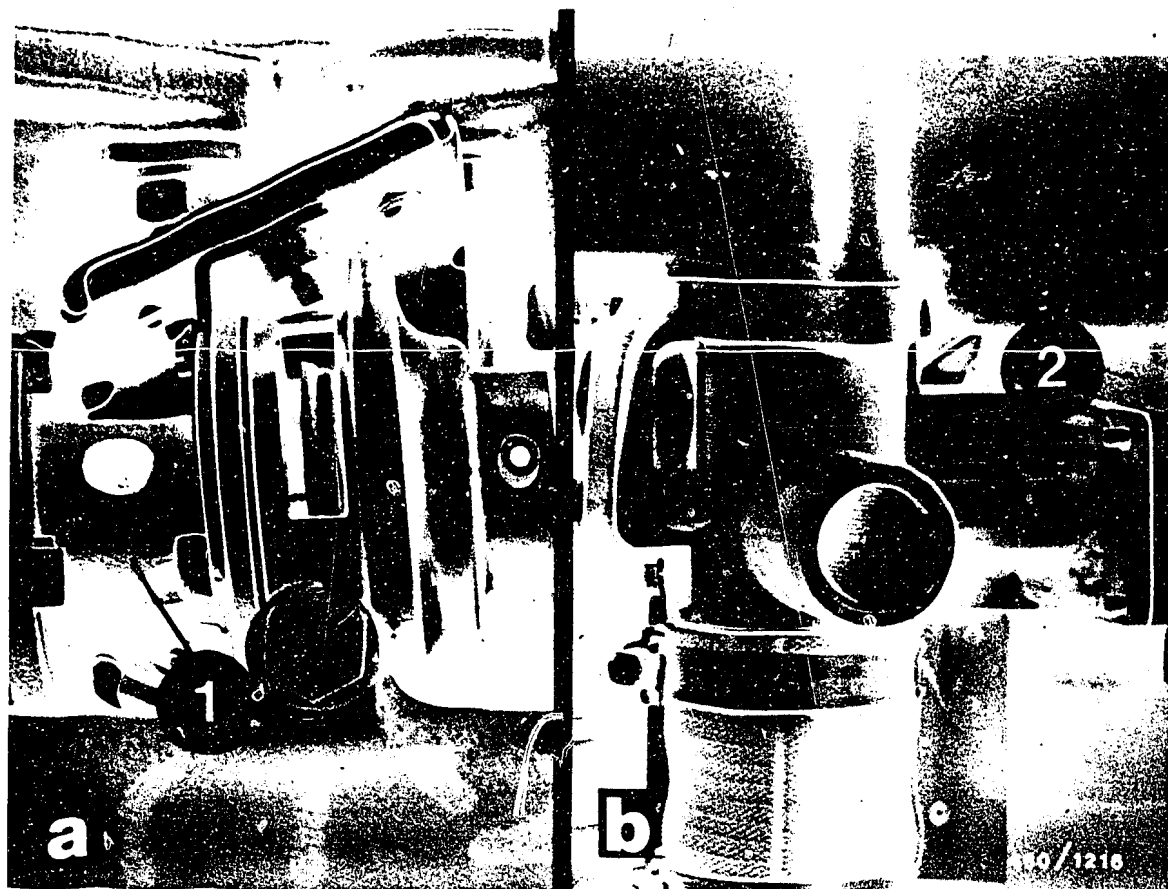
2 = Intake-air temperature sensor
(In the air-flow sensor)



1 = Atmospheric-pressure sensor
(Spring-strut dome, right)

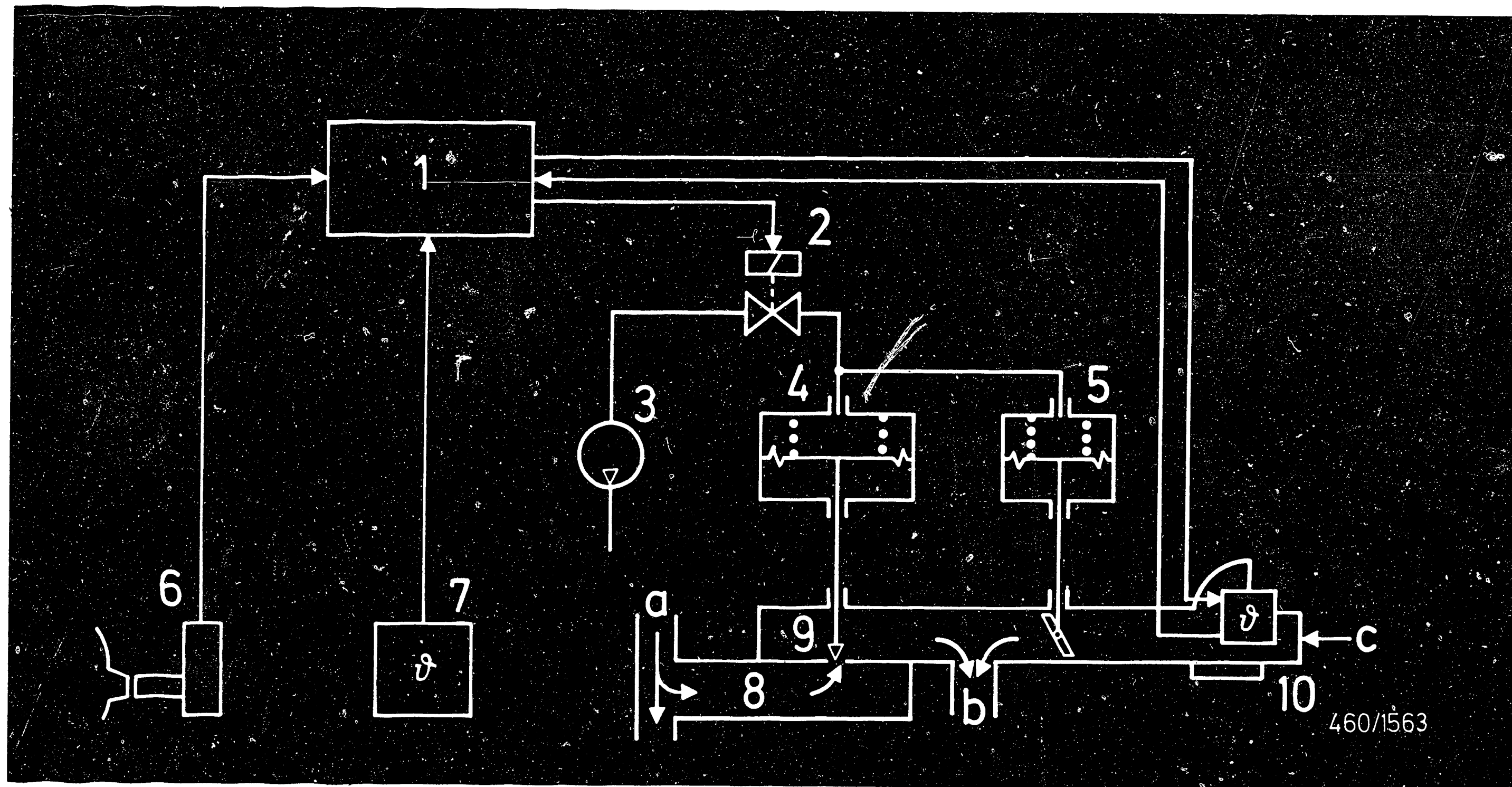
2 = Reversed-polarity protection relay of the ctrl. units
(Spring-strut dome, right)

3 = Gear-shift valve
(Automatic vehicle only)



- 1 = Exhaust-gas-recirculation valve
(On exhaust manifold)
- 2 = Throttle valve
(Between turbocharger and charge-air pipe)

For production reasons:
continued on the following
coordinate.



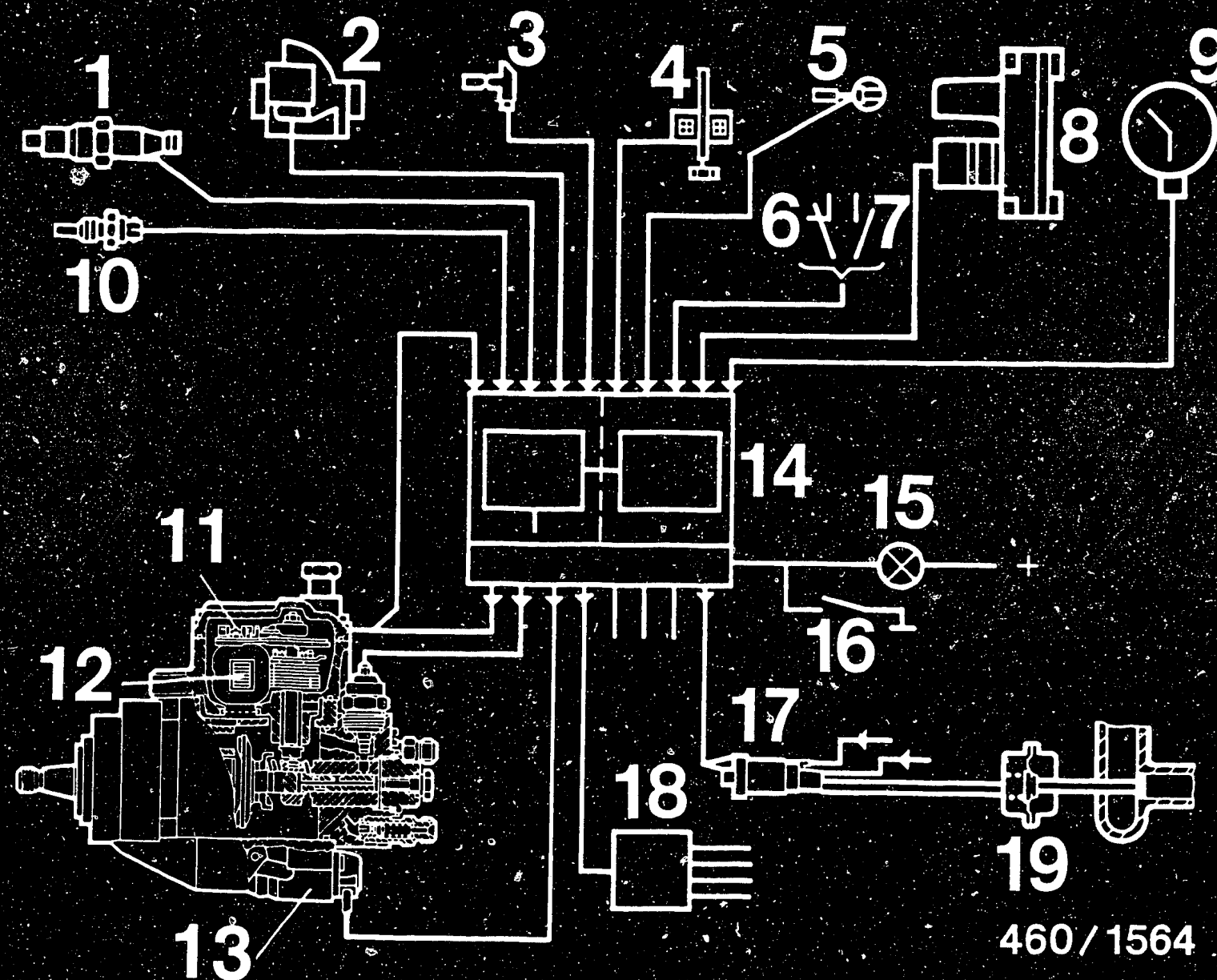
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GENERAL PLAN OF THE EXHAUST-GAS RECIRCULATION (EGR) WITH CLOSED-LOOP CONTROL

- 1 = Start-of-injection and exhaust-gas-recirculation control units
- 2 = Exhaust-gas-recirculation actuator
- 3 = Vacuum pump (engine)
- 4 = Exhaust-gas-recirculation valve
- 5 = Throttle-valve assembly
- 6 = Engine-speed sensor
- 7 = Coolant-temperature sensor

- 8 = Exhaust pipe
- 9 = Charge-air pipe
- 10 = Air-flow sensor

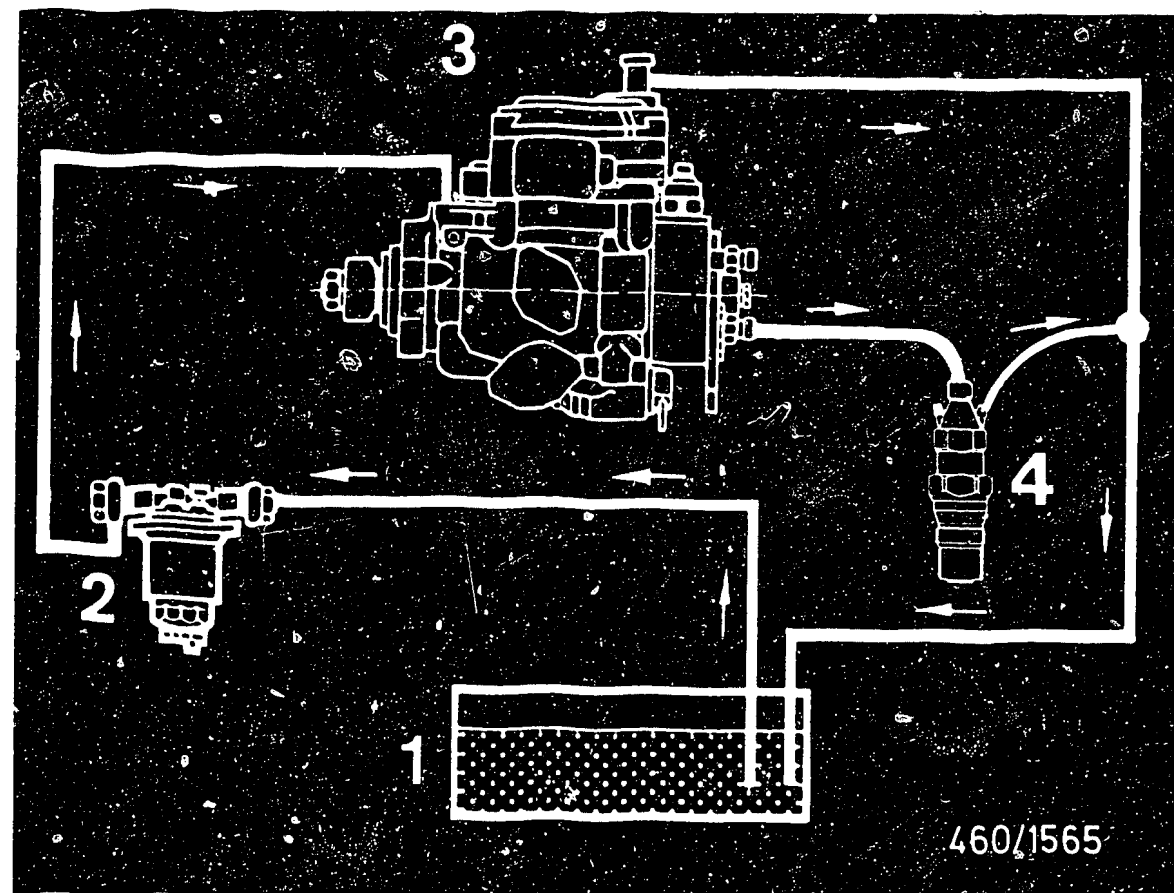
- a = Engine exhaust gas
- b = Engine intake air
- c = Fresh gases



SYSTEM OVERVIEW - EDC - Peugeot 505 Turbo Diesel

- 1 = Nozzle-holder assembly with needle-movement sensor
- 2 = Air-flow sensor with intake-air temperature sensor
- 3 = Engine-speed reference-mark sensor
- 4 = Speed sensor
- 5 = Operating lever, road-speed control
- 6 = Clutch-pedal switch
- 7 = Brake-pedal switch
- 8 = Charge-air-pressure/atmospheric-pressure sensors

- 9 = Accelerator pedal
- 10 = Coolant-temperature sensor
- 11 = Fuel-temperature sensor
- 12 = Delivery controller
- 13 = Sol.-op.-val. start of inj.
- 14 = Control unit
- 15 = Diagnostic indicator
- 16 = Flashing-clode call-up but.
- 17 = Electro pneumatic pressure transducer
- 18 = Glow-duration control unit
- 19 = EGR valve

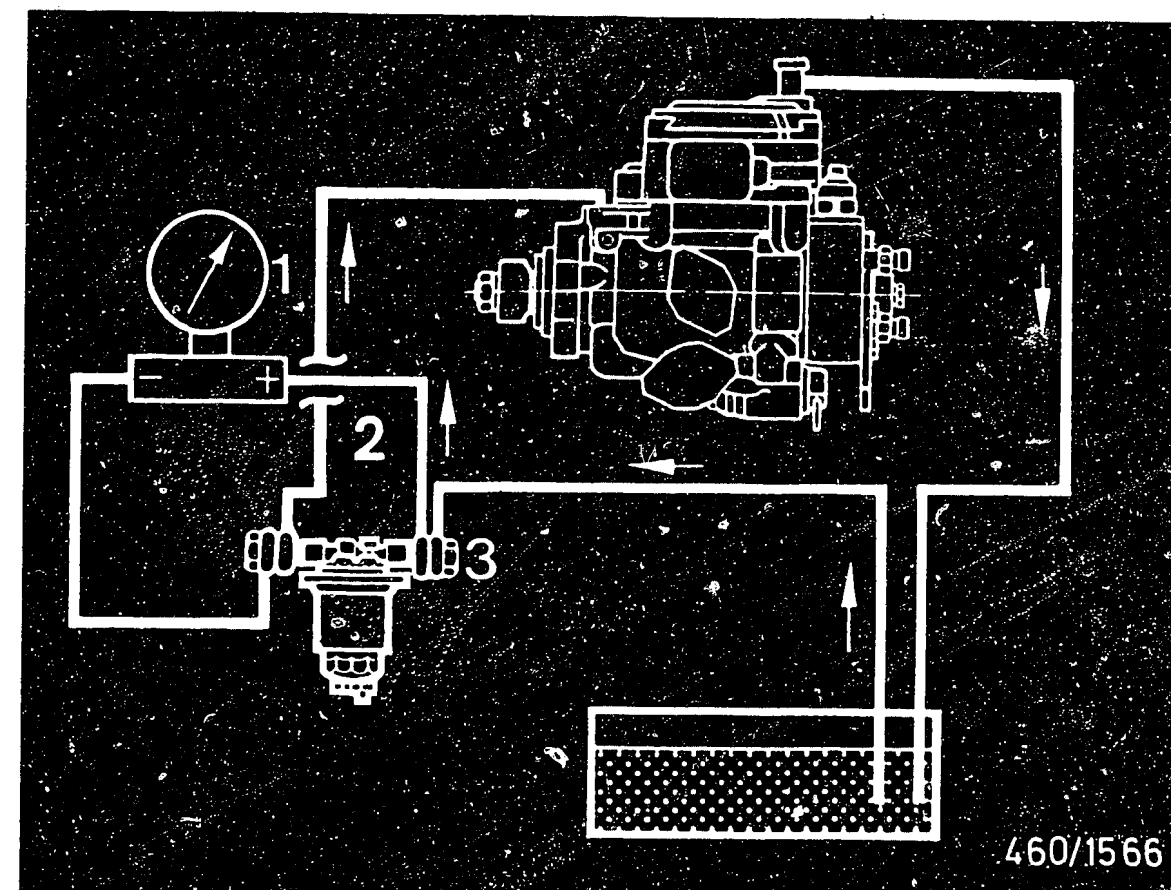


- 1 = Fuel tank
- 2 = Fuel filter
- 3 = Distributor-type fuel-injection pump
- 4 = Injection nozzles

DIAGRAM OF FUEL LINES

The fuel lines are connected in accordance with the scheme shown above.

The fuel flows in the direction of the arrow.



- 1 = Differential-pressure gauge
- 2 = Filter outlet
(Use inlet union and extra long inlet-union screw 2 443 456 020)
- 3 = Filter inlet
(Use inlet union and extra long inlet-union screw 2 443 456 020)

Connection diagram for filter test

Connect the differential-pressure gauge to the fuel filter via the appropriate connection pieces.

TROUBLE-SHOOTING

* Using the self-diagnosis

The control units of the electronically controlled diesel fuel injection (EDC = Electronic Diesel Control) have a self-diagnosis system at their disposal for the purpose of detecting defective peripheral components and/or line paths.

Therefore, always begin trouble-shooting (testing) with self-diagnosis.

If several faults are present and can be called up in turn via the self-diagnosis, make a note of the flashing-code data. If the voltage supply for the control units is interrupted, the faults stored are cleared. As a result, faults which momentarily cannot be registered (e.g. intermittently occurring loose contacts) cannot be identified as the cause of trouble.

If a faulty function path is indicated, pay particular attention to:

- * Loose contacts at multiple plug
- * Fouled, deformed or corroded plug-in contacts.
- * Breaks in leads at kinked or pinched locations.

Test information:

Before disconnecting or connecting control-unit plugs, switch off the ignition.

Clear the flashing code of the fault stored and trigger self-diagnosis once again as a check.

Trouble-shooting (continued)

The self-diagnosis test table starting on Coordinate B13 contains fault indication (comprising flashing pulses), cause of trouble, test instructions and the coordinate details for purposeful trouble-shooting in the self-diagnosis trouble-shooting program.

If no fault is indicated under self-diagnosis and the customer complaint has still not been eliminated, trouble-shooting must be continued with the trouble-shooting chart starting at Coordinate B04.

* Using the trouble-shooting chart

The trouble-shooting chart starting on Coordinate B04 contains customer complaints (symptoms of trouble), cause of trouble, test instructions and a coordinate reference which refers you to:

- * purposeful trouble-shooting in the trouble-shooting program
- * self-contained component testing
- * notes on the removal and installation of components.

The possible cause of the trouble must be selected from the trouble-shooting chart in accordance with the customer complaint (symptom of trouble).

* Using the trouble-shooting program

The self-diagnosis trouble-shooting program starting at Coordinate B27 and the trouble-shooting program (for faults which cannot be identified via self-diagnosis) starting at Coordinage E21 are divided into three rows of boxes in each case.

The left-hand column contains test instructions and, if necessary, test specifications. If there are no test specifications given, these must be taken from the corresponding brief instructions.

The center column contains repair instructions.

The right-hand column contains the illustrations/terminal diagrams belonging to the text and the key to the items in the illustration.

If the questions in the left-hand column can be answered conclusively with "yes", continue trouble-shooting with the next box down.

If the answer to the questions is "no", branch to the center column and carry out the tests in the order given there.

When all the tests on one component have been completed, reference is made to the self-diagnosis test tables starting at Coordinate B13 and to the trouble-shooting chart starting at Coordinate B04 for the purpose of eliminating any possible further faults (determined via the flashing code or symptom of trouble).

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Fault lamp lights/flashes
2. Starting motor operates, but engine fails to start or starts only with difficulty (warm and cold)
3. Engine hunts at idle
4. Rough idling when engine is warm
5. High fuel consumption in conjunction with unsatisfactory engine performance and smoke formation
6. Vehicle performance inadequate
7. Black smoke in full-load range in conjunction with harsh running of engine, and possible poor performance
8. Engine runs harsh

						Cause (component fault)	Coord.
*						Self-diagnosis	B07
	*					Supply, control units	E21
		*				Delivery controller	C19
			*			Rotational-angle potentiometer	C11
				*		ELAB	G08
	*			*	*	Computer monitoring	E17 E19
				*	*	Solenoid-operated-valve start of injection	E01
				*		Pressure transducer - EGR	D13
				*		Nozzle-holder assembly with needle-movement sensor	D23
				*		Computer interface	E09 E13
	*				*	Engine-speed sensor	D17
	*					Engine-speed sensor and needle-movement sensor	D17 D23
	*					Tank empty, tank ventilation	G11
	*	*			*	Injection sequence, not firing sequence	G10

TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

1. Fault lamp lights/flashes
2. Starting motor operates, but engine fails to start or starts only with difficulty (warm and cold)
3. Engine hunts at idle
4. Rough idling when engine is warm
5. High fuel consumption in conjunction with unsatisfactory engine performance and smoke formation
6. Vehicle performance inadequate
7. Black smoke in full-load range in conjunction with harsh running of engine, and possible poor performance
8. Engine runs harsh

Cause (component fault)							Coord.
	*					Inlet-union screws, fuel inlet/ fuel return	J14
*		*				Air in fuel system	G12
*						Paraffin separation	G14
*			*			Fuel lines leaking	G20
*						Supply lines clogged	G19
*		*	*	*	*	Injection nozzle	H04
*		*	*	*		Coordination, pump - engine (injection timing)	K11
*						Fuel filter	G14 H12
*						Preheating system	F20
*		*	*			Engine compression	H16
*	*	*	*	*		Fuel-injection pump	H26
			*			Engine air filter	H03
			*			Engine timing	J20
				*		Timing device	H15
			*			Turbocharger	K23

B05

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TROUBLE-SHOOTING (Continued)

Customer complaint (symptoms of trouble)

- 9. Misfiring when driving
- 10. Engine cuts out arbitrarily
- 11. Engine runs at constant speed
- 12. Engine does not run fast when cold
- 13. Fast idling and/or engine not running smoothly at high engine speed
- 14. Black smoke in full-load range
- 15. Foglike smoke in full-load range (white)

Cause (component fault)						Coord.
	*				Accelerator pedal	C07
*					Delivery controller	C19
*			*		Rotational-angle potentiometer	C11
*					Computer monitoring	E17 E19
*					Engine-speed sensor and needle-movement sensor	D17
*	*	*		*	Tank empty, tank ventilation	G11
	*	*		*	Injection sequence, not firing sequence	G10
*		*		*	Inlet-union screws, fuel inlet/fuel return	J14
*		*		*	Air in fuel system	G12
		*			Paraffin separation	G14
*					Fuel lines leaking	G20
*		*		*	Supply lines clogged	G19
		*		*	Coordination, pump - engine (injection timing)	K11
		*		*	Fuel filter	G14H12
		*			Engine compression	H16
		*		*	Fuel-injection pump	J02
				*	Exhaust-gas recirculation	F17

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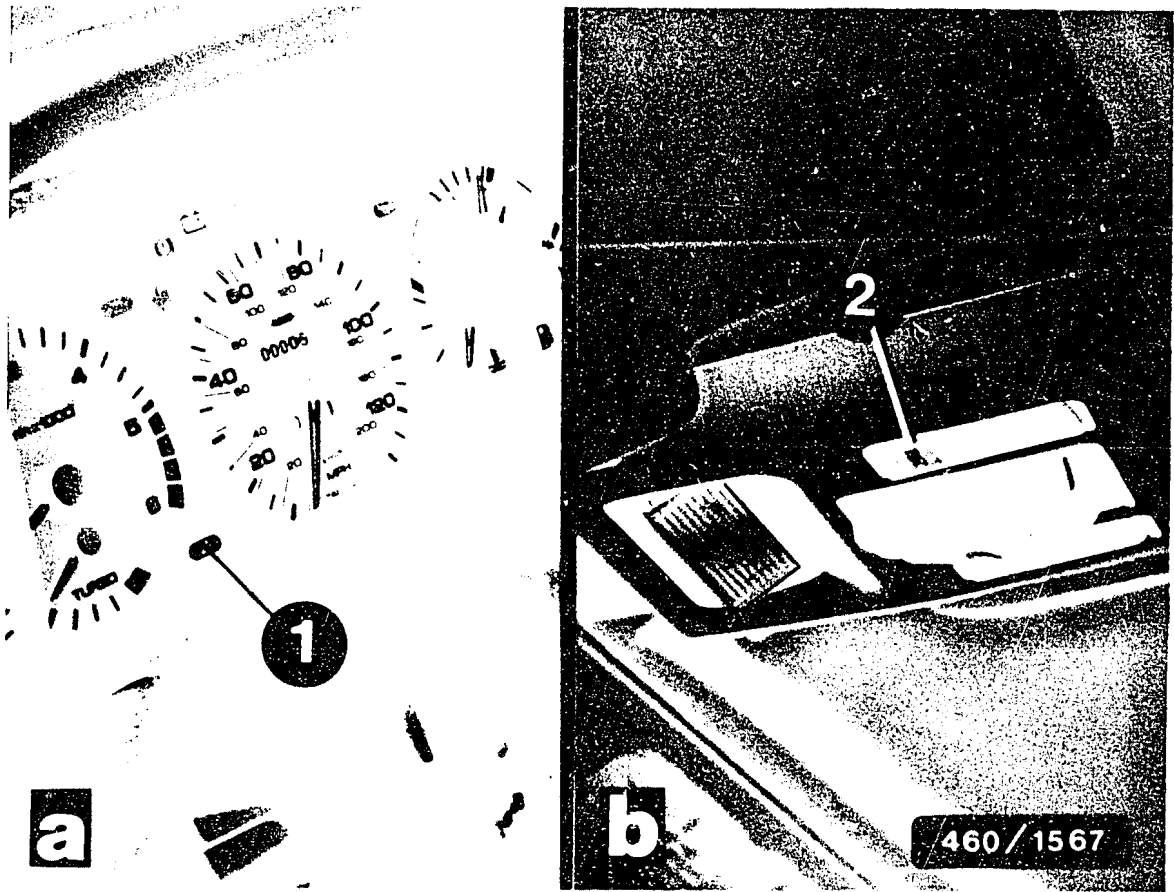
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TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

16. Road-speed control not operating
17. Road-speed control cannot be switched off
18. Reinstatement of road speed impossible
19. Exhaust-gas recirculation not operating

					Cause (component fault)	Coord.
	*				Computer monitoring	E17 E19
	*				Solenoid-operated-valve start of injection	E01
	*				Pressure transducer - EGR	D13
	*				Nozzle-holder assembly with needle-movement sensor	D23
*	*				Engine-speed sensor	D17
*	*				Speed sensor	C23
*					Gear-shift valve (on automatic only)	E25
*					Switch, road-speed control On	F01
*	*				Switch, clutch/brake	F05
	*				Switch, road-speed control Off	F09
	*				Switch road-speed control Reinstatement	F13
		*			Air-flow sensor	D05
		*			Intake-air temperature sensor	B27
		*			Coolant-temperature sensor	C01
*					Pressure transducer, road-speed control (on automatic only)	C25



SELF-DIAGNOSIS VIA FLASHING-CODE EVALUATION

An integrated self-diagnosis system in the two control units (output through control unit 2 only) makes it possible to locate a faulty component or line path via a flashing code. Indication is given by means of an indicator lamp in the instrument panel, this lamp lighting or flashing in the case of a fault (illustration a).

The diagnostic program is activated by pressing the diagnostic button (Test).

The program then starts with a start code 1.2 (= 1 flashing pulse - pause - 2 flashing pulses) and ends with an end code 1.1.

Self-diagnosis (continued)

The flashing codes indicated between the start and end codes indicate the faulty function path.

If there is no fault, the indicator light goes out as soon as the engine is running, i.e. when engine-speed pulses are present.

If there is a slight fault (e.g. temperature sensor (intake air) defective), the indicator lamp goes out approx. 30 seconds after the engine has been started. During this period, not only faults which are momentarily present, but also past faults stored are indicated to the driver. If the indicator lamp goes out, the relevant flashing code can be called up again by actuating the diagnostic button.

In the case of serious faults, the indicator lamp permanently remains in the indication mode (steady light) after the engine has been started. The indicator lamp is, however, activated only for as long as the fault is present (no indication of stored faults).

If several faults are simultaneously present, they can be called up one after the other. Detected faults are stored, i.e. faults which are limited with respect to time (e.g. loose contact at multiple butt connector) are also not cleared when the ignition is switched off.

N o t e:

If the voltage supply for the control units is interrupted, the stored faults of the self-diagnosis are cleared.

* Breakdown of self-diagnosis (flashing code)

- 1.1 Program end code
- 1.2 Program start code
- 1.3 Temperature sensor (intake air) *
- 1.4 Temperature sensor (coolant) *
- 1.5 Fuel-temperature sensor *
- 2.1 Accelerator pedal
- 2.2 Rotational-angle potentiometer
- 2.3 Delivery controller
- 2.4 Road-speed sensor *
- 2.5 Pressure transducer, road-speed control *
- 3.1 Atmospheric-pressure sensor *
- 3.3 Air-flow sensor
- 3.4 Pressure transducer, exhaust-gas recirculation
- 4.1 Engine-speed sensor
- 4.2 Needle-movement sensor
- 4.3 Solenoid-operated-valve start of injection
- 5.1 Computer interface, control unit (stored fault)
- 5.2 Computer interface, control unit (present fault) and/or computer monitoring, control unit 1

Steady light (flashing code cannot be called up)
Computer monitoring, control unit 2

N o t e:

* = Slight fault, indicator lamp of self-diagnosis goes out 30 seconds after the engine has been started.

Flashing-code evaluation

1. Actuate the diagnostic button (Test) for at least 1 second in order to avoid incorrect tripping.
2. Start code 1.2 of the diagnosis program is indicated.
3. Wait until the indicator lamp lights up again and then actuate the test switch once again.
4. Flashing code of the corresponding faulty component is indicated.
5. Actuate the diagnostic button again. If there is no further fault, the end code 1.1 is indicated.

Clearing the flashing code

1. Switch on the ignition.
2. Actuate the brake pedal and test switch simultaneously for at least 1 second.
3. Call up the diagnosis program anew by pressing the diagnostic button.
4. If the end code 1.1 is indicated after the start code 1.2, the stored flashing code for the respective faulty component is cleared.

Testing the self-diagnosis:

Switch on the ignition:
Indicator lamp must light up.

Press the diagnostic button:
Start code 1.2 and end code 1.1 must be indicated.

If operation is disrupted, carry out the following tests:

1. Test the bulb, and replace if necessary.
2. Test the diagnostic button, and replace if necessary.
3. Test the following electric leads for open circuit:
 - * Control unit 2 term. 21 - indicator lamp
 - * Indicator lamp - fuse term. 15
 - * Diagnostic button - indicator lamp
 - * Diagnostic button - ground

SELF-DIAGNOSIS TEST TABLE

Fault indication Flash code	Testing of component/function	Test instructions / Test conditions	Terms.	Set values	Coordinate
1.3	Intake-air temperature sensor	Test resistance of NTC 1 at air-flow sensor at +15...+30°. Test measuring voltage (control unit) at disconnected cable connector.	1 - 4 1 - 4	1.3...3.6 k Ω approx. 5 V	B27
1.4	Coolant-temperature sensor	Test resistance of NTC 2 at component. +15...+30°C; Approx. + 80°C; Test measuring voltage (control unit) at disconnected cable connector.		1.3...3.6 k Ω 250...390 Ω approx. 5 V	C01
1.5	Fuel-temperature sensor	Perform tests at 7-pin cable connector of EDC distributor-type fuel-injection pump with the aid of test adapter KDEP 1160 or KDEP 1165 * Short circuit to ground Connect adapter to cable connector to injec. pump * Short circuit Connect adapter to cable connector to injec. pump * Internal resistance at +15...+30°C: Connect adapter to cable connector to injec. pump * Measuring voltage (control unit): Connect adapter to cable connector to control unit	5-grd. 6-grd. 4 - 6 5 - 6 5 - 6	> 1 M Ω > 1 M Ω > 1 M Ω see brief instruc. approx. 5 V	C03
2.1	Accelerator pedal	Perform tests at component. * Internal resistance * Supply voltage * Voltage signal - idle position - full-load position	1 - 3 1 - 3 (-) (+) 1 - 2 1 - 2	see brief instruc. 4.8...5.2 V see brief instruc. see brief instruc.	C07

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

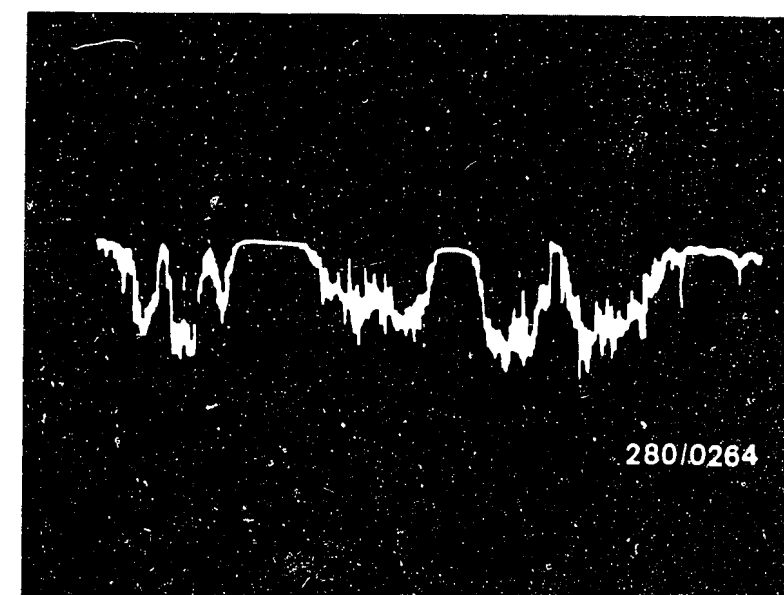
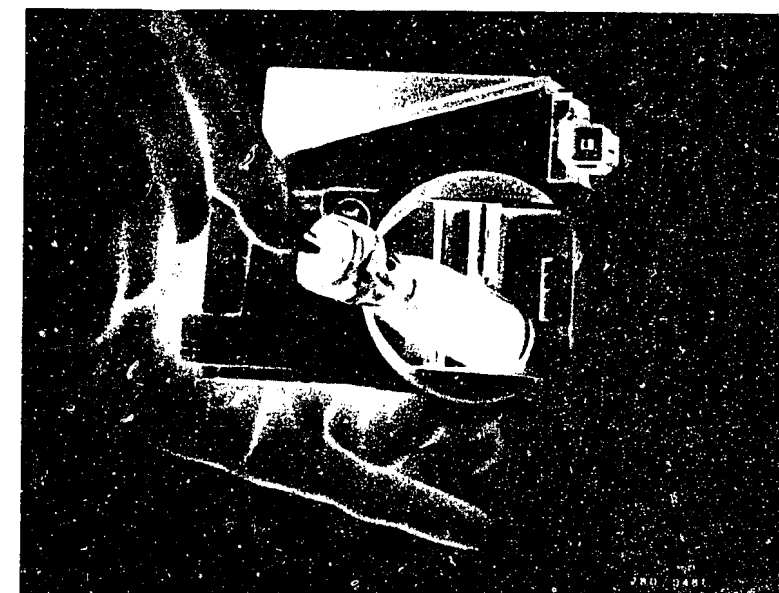
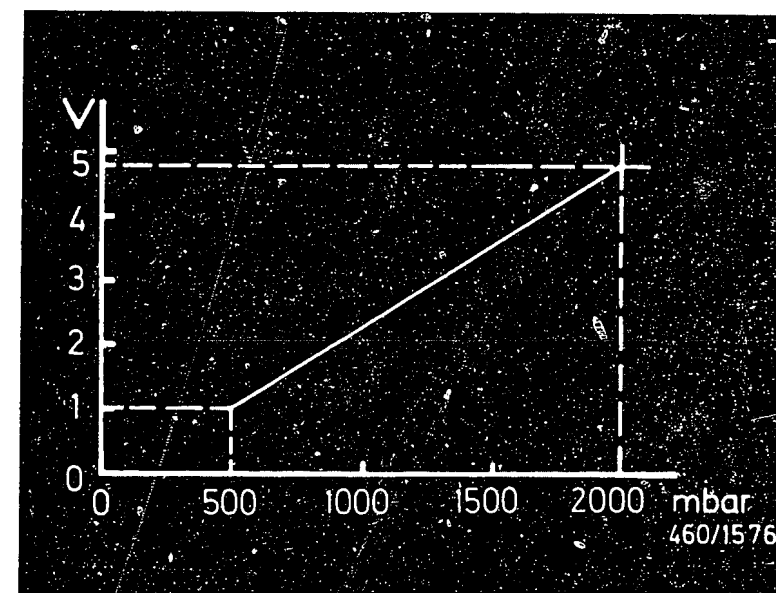
Fault indication Flash code	Testing of component/function	Test instructions/Test conditions	Terms.	Set values	Coordinate
2.2	Rotational-angle potentiometer	<p>Perform tests at 7—pin cable connector of EDC distributor-type fuel-injection pump with the aid of test adapter KEDP 1160 or KDEP 1165.</p> <p>* Short circuit to ground Connect adapter to cable connector to injection pump</p> <p>* Short circuit Connect adapter to cable connector to injection pump</p> <p>* Resistance, potentiometer path Connect adapter to cable connector to injection pump.</p> <p>* Resistance, wiper path Connect adapter to cable connector to injection pump.</p> <p>* Supply voltage Connect adapter to cable connector to control unit.</p> <p>* Voltage signal Connect both cable connectors to adapter. Disconnect cable connector from coolant-temperature sensor and needle-movement sensor.</p> <p>* Connect cable connector to needle-movement sensor.</p>	<p>1—grd. 2—grd. 3—grd.</p> <p>2 — 7</p> <p>2 — 3</p> <p>1 — 3</p> <p>2 — 3 (+) (-)</p> <p>1 — 3</p>	<p>> 1 M Ω > 1 M Ω > 1 M Ω</p> <p>> 1 M Ω</p> <p>see brief instruc.</p> <p>see brief instruc.</p> <p>4.8...5.2 V</p> <p>see brief instruc.</p> <p>see brief instruc.</p>	C11

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault ind. Flash code	Testing of component/function	Test instructions/Test conditions	Terms.	Set values	Coor- dinate
2.3	Delivery controller	<p>Carry out test at 7-pin cable connector of EDC distributor-type fuel-injection pump with the aid of the test adapter KDEP 1160 or KDEP 1165.</p> <p>* Short circuit to ground Connect adapter to cable connector to inj. pump.</p> <p>* Internal resistance Connect adapter to cable connector to inj. pump.</p> <p>* Supply voltage Connect adapter to cable connector to control unit.</p>	<p>4-grnd. > 1 M Ω 7-grnd. > 1 M Ω</p> <p>4 - 7</p> <p>3 - 7 (-) (+)</p>	<p>> 1 M Ω > 1 M Ω</p> <p>See brief instructions</p> <p>8.0...14.5 V</p>	C19
2.4	Speed sensor	<p>Test internal resistance at components at *15...50°C.</p> <p>Test measuring voltage (control unit) at disconnected cable connector.</p>		<p>See brief instructions</p> <p>approx. 5 V</p>	C23
2.5	Pressure transducer, road-speed control	<p>Test internal resistance at components at approx. 20°C.</p> <p>Test measuring voltage (control unit) at disconnected cable connector.</p>		<p>5.0...6.0 Ω</p> <p>approx. 12 V</p>	C27

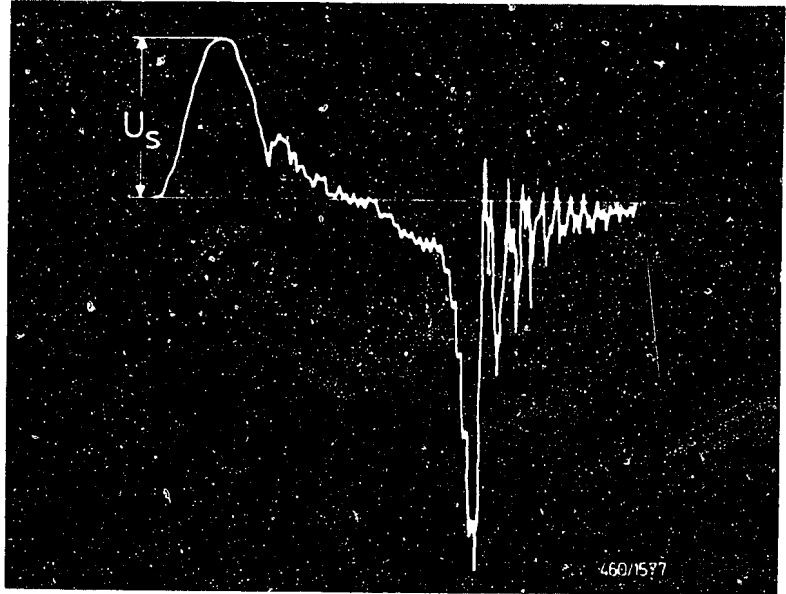
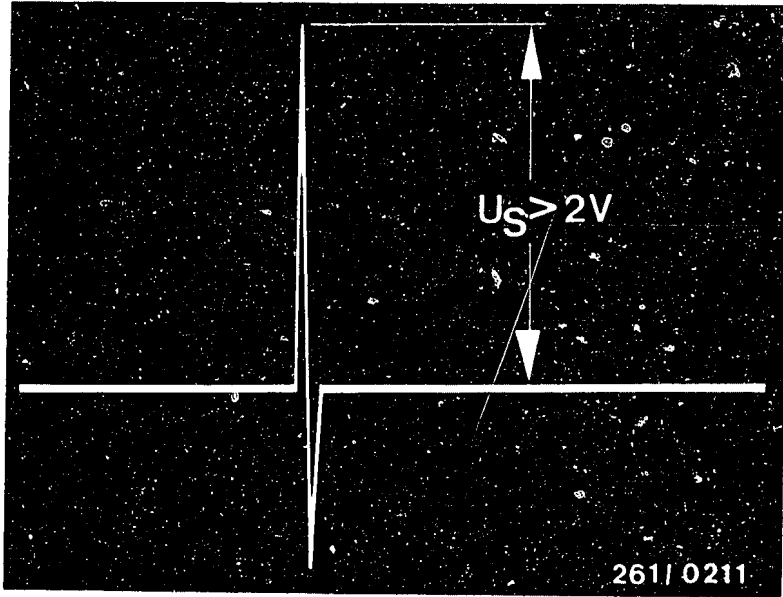
SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indic. Flash code	Testing of component/function Test instructions/conditions	Terms.	Set values	Coordinate
3.1	Atmospheric-pressure sensor. Perform test at component. * Supply voltage * Voltage signal (determine barometric pressure)	1 - 3 1 - 2	4.8...5.2 V see characteristic curve	D01
3.3	Air-flow sensor. Perform tests at component. * Overall resistance * Supply voltage * Voltage signal - by changing the position of the sensor flap of the air-flow sensor * Noise test - motortester, special input	3 - 4 3 - 4 (+) (-) 2 - 4 2 - 4	see brief instruc. 4.8...5.2 V see brief instruc. Noise signal of faulty air-flow sensor (see illustration)	D05
3.4	Pressure transducer, exhaust-gas recirc. * Test internal resistance at component at approx. + 20° C * Test measuring voltage (control unit) at cable-connector component * Actuation on/off ratio - coolant temperature approx. 80° C - connect pockettester to pressure transducer - adjust dwell-angle range - run engine at idle speed - Disconnect cable connector from coolant-temperature sensor or air-flow sensor. Test instruction: on/off ratio must change on disconnecting one of the components.		5.0...6.0 Ω approx. 12 V Read off on/off ratio at tester see brief instruc.	D13



SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flash code	Testing of component/ function Test instructions/conditions	Term.	Set values	Coor- dinate
4.1	Engine-speed sensor Perform tests at cable connector of component. * Short circuit to ground * Internal resistance at approx. 20°C * Engine-speed signal pattern - motortester, special input - run engine at idle speed Note: Positive signal peak must come first	1 - 2 (+) (-)	> 1 M Ω see brief instruc. see signal pattern	D17
4.2	Perform tests on needle-movement sensor at cable connector of component. * Short circuit to ground * Internal resistance approx.+20°C approx.+80°C * Supply voltage - cable connector disconnected - cable connector connected at approx. + 80° C * Needle-lift signal/signal voltage (U_s) - cable connector connected - run engine at idle speed - motortester, special input		> 1 M Ω see brief instruc. see brief instruc. see brief instruc. see brief instruc. see signal pattern U_s = see brief instructions	D23



SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flash code	Testing of component/function	Test instructions/Test conditions	Set values	Coord.									
4.3	Solenoid-operated-valve start of injection	<p>Perform tests at cable connector of component.</p> <ul style="list-style-type: none">* Short circuit to ground* Internal resistance at approx. + 60° C* Test measuring voltage (control unit) at disconnected cable connector.* Actuation, on/off ratio<ul style="list-style-type: none">- coolant temperature approx. 80° C- connect pockettester at connected cable connector- adjust dwell-angle range- run engine at idle speed- disconnect cable connector at needle-movement sensor <p>- Connect cable connector to needle-movement sensor</p> <p>Test instruction: On/off ratio must change on disconnecting the needle-movement-sensor plug and/or on engine-speed increase.</p>	<p>> 1 M Ω</p> <p>see brief instruc.</p> <p>approx. 12 V</p> <p>see brief instruc.</p> <p>see brief instruc.</p>	E01									
5.1	Computer interface, control unit (stored fault)	<p>Fault n o t present at time of testing. Disconnect control-unit plugs 1 and 2.</p> <p>Following this, test the leads listed for open circuit/contact resistance:</p> <table><tr><td>Control-unit plug 1</td><td></td><td>Control-unit plug 2</td></tr><tr><td>Term.14</td><td>to</td><td>Term. 9</td></tr><tr><td>Term.15</td><td>to</td><td>Term.12</td></tr></table>	Control-unit plug 1		Control-unit plug 2	Term.14	to	Term. 9	Term.15	to	Term.12	approx. 0 Ω	E09
Control-unit plug 1		Control-unit plug 2											
Term.14	to	Term. 9											
Term.15	to	Term.12											

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault ind. Flash code	Testing of component/function	Test instructions/test conditions	Terms.	Set values	Coordi- nates
5.2	Computer interface, control unit (present fault)	Fault is present at time of testing. Disconnect control-unit plugs 1 and 2. Afterwards, test the leads listed below for open circuit and contact resistance: Control-unit plug 1 Control-unit plug 2 Term. 14 to Term. 9 Term. 15 to Term. 12		aprx. 0 Ω	E13
5.2	Computer monitoring, control unit 1	Fault in computer monitoring is present only if the engine c a n n o t be started when a flashing code is indicated. Replace control unit 1.			E17
Steady light	Computer monitoring, control unit 2	Indicator lamp of self-diagnosis is lit with steady light and n o flashing code is indicated when the test switch is actuated. Exhaust-gas recirculation switched off. Dis. multiple butt con. from sol.-op. valve start of inj. Test the measuring voltage (control unit) at the multiple butt connector.		aprx. 12 V	E19

SELF-DIAGNOSIS TEST PROGRAM (1)

Flashing code: 1.3

N>

Component:
Intake-air temperature sensor
(upper illustration - arrow)

Test 1: Resistance

Disconnect cable connector
from air-flow sensor.

Connect ohmmeter with test
leads KDUM 0008 to air-flow
sensor term. 1 and term. 4
(center illustration).

Set value:
at +15...+30° C:
1.3...3.6 k Ω

Is set value obtained?

Test 2: Measuring voltage,
control unit

N>

Connect voltmeter with test
leads KDZS 0004 to cable
connector term. 1 and term. 4.

Switch on ignition.

Set value: approx. 5 V

Is set value obtained?

Return to self-diagnosis
test table B13

Intake-air temperature sensor
defective, replace air-flow
sensor.

Switch off ignition.

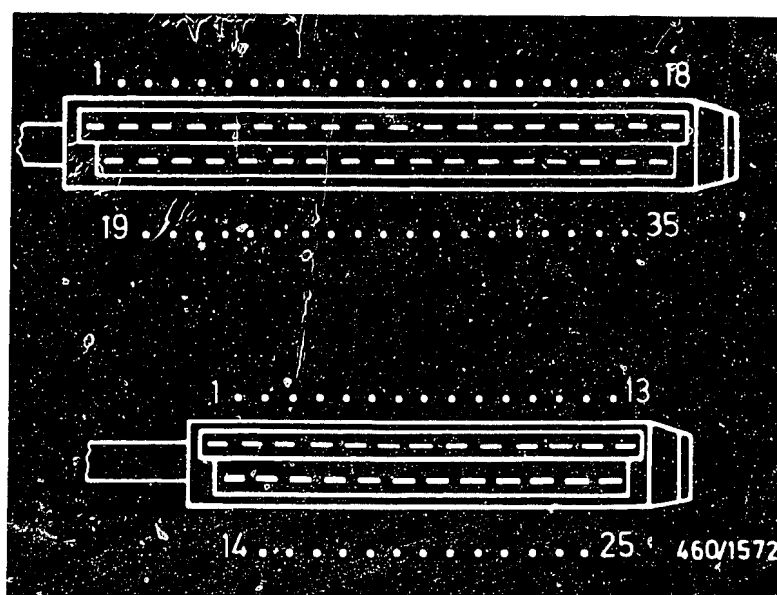
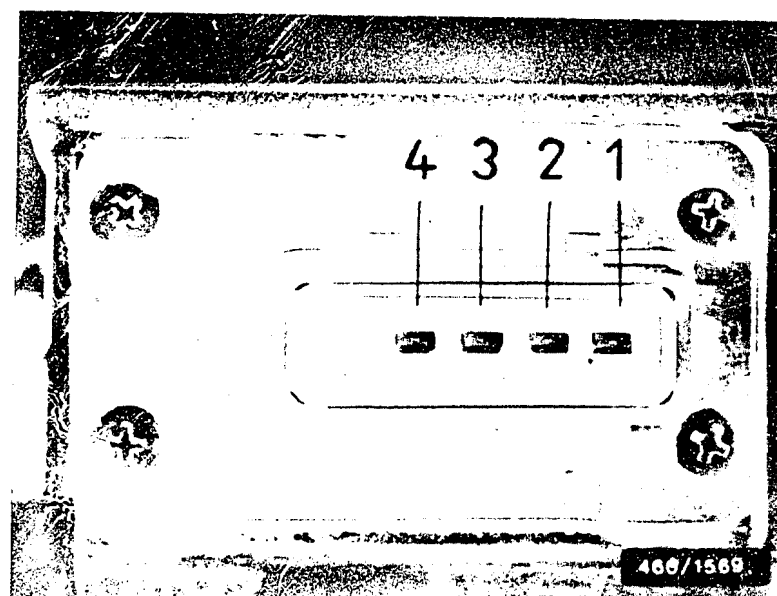
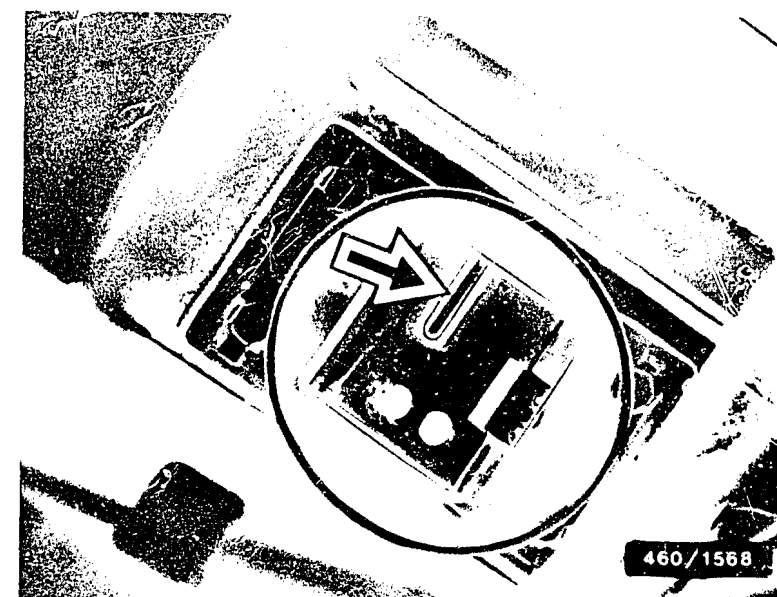
Disconnect control-unit plugs
1 and 2.

Test leads term. 4 at control-
unit plug 2 and term. 26 at
control-unit plug 1 (lower
illustration) to air-flow
sensor with test leads KDZS 0004
for open circuit and/or contact
resistance.

Bridge leads term. 1 and term. 4
at cable connector of air-flow
sensor.

Set value: approx. 0 Ω

If set value is obtained,
replace control unit 1.



SELF-DIAGNOSIS TEST PROGRAM (2)

Flashing code: 1.4

Component:
Coolant temperature sensor
(upper illustration, arrow)

Test 1: Resistance

Disconnect cable connector
from temperature sensor.

Connect ohmmeter with test
leads KDUM 0008 to both
terminal posts of the
temperature sensor.

Set value:
at
+15...+30° C = 1.3...3.6 k Ω
approx. +80° C = 250...390 Ω

Is set value obtained?

N>

Coolant-temperature sensor
defective, replace.

Test 2: Measuring voltage,
control unit

Connect voltmeter with test
leads KDZS 0004 to cable
connectors of temperature
sensor.

Switch on ignition.

Set value: approx. 5 V

Is set value obtained?

N>

Switch off ignition.

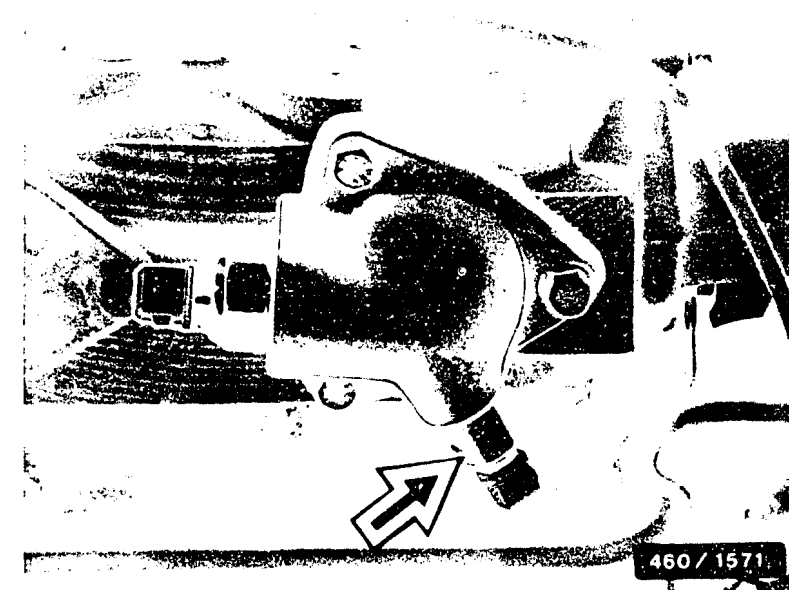
Disconnect control-unit plug 1
and test leads from term. 23 and
term. 35 to temperature sensor
with test leads KDZS 0004
for open circuits and/or
contact resistance.

Bridge leads at cable connector
(temperature sensor).

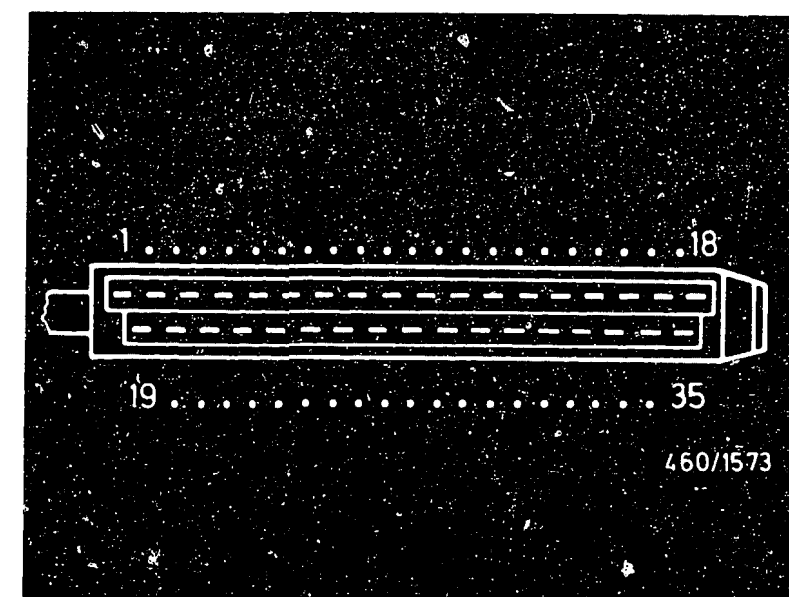
Set value : approx. 0 Ω

If set value is obtained,
replace control unit 1
(lower illustration arrow).

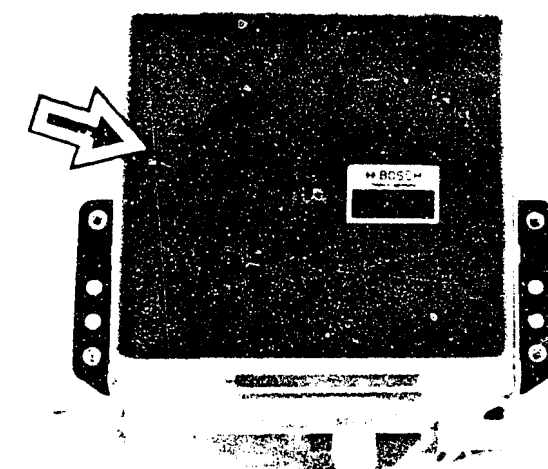
Return to self-diagnosis
test table B13



460/1571



460/1573



460/1574

SELF-DIAGNOSIS TEST PROGRAM (3)

Flashing code: 1.5

Component:
Fuel-temperature sensor
(upper illustration, arrow)

Test 1: Short circuit to ground

Disconnect cable connector
(1, center illustration) from
fuel-injection pump.

Connect test adapter KDEP 1160
or KDEP 1165 (1,) to connection
lead (2, lower illustration)
to fuel-injection pump.

Connect ohmmeter with commer-
cially available test leads
to measuring sockets listed
below.

5 and ground
6 and ground

Set value: > 1 M Ω

Is set value obtained?

Test 2: Short circuit

Connect ohmmeter with commer-
cially available test leads
to measuring sockets 4 and 6.
Set value: > 1 M Ω

Is set value obtained?

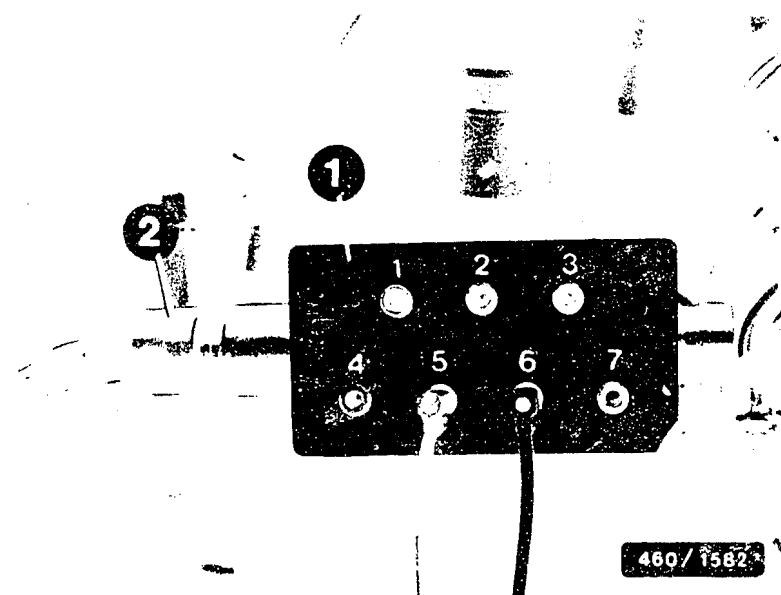
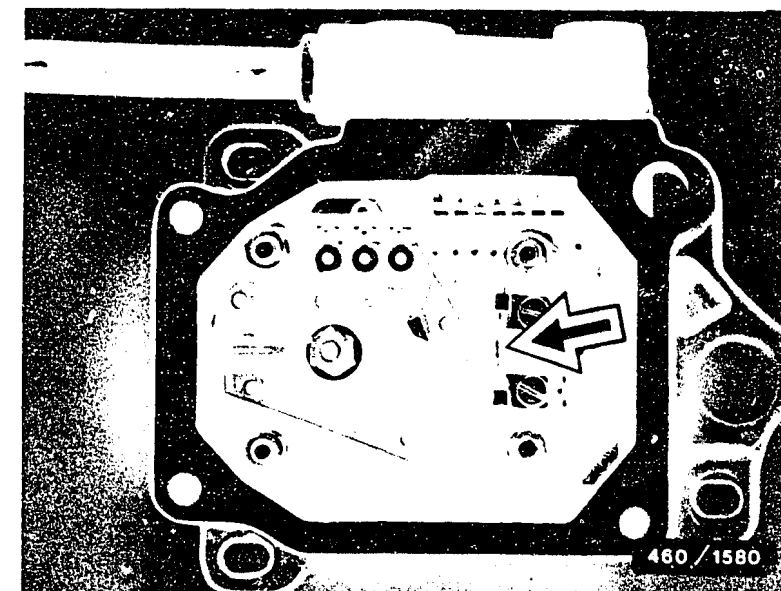
Continued on next picture page

Remove closing cover from
delivery controller.

Test terminal post and con-
ductors of potentiometer
for short circuit to ground.

If necessary, replace temp-
erature sensor and/or delivery
controller.
(Potentiometers cannot be
exchanged separately).

N o t e:
Make sure everything is clean
and use new gasket.



SELF-DIAGNOSIS TEST PROGRAM (3) (CONTINUED)

Test 3: Internal resistance

Connect ohmmeter with commercially available test leads to measuring socket 5 and 6 (upper illustration).

Set value: see brief instruc.

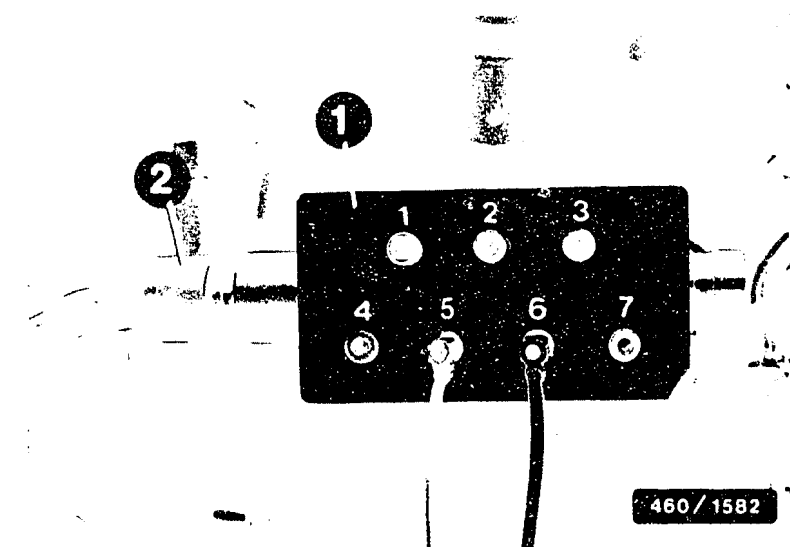
Is set value obtained?

N>

Temperature sensor defective, replace.

Remove closing cover from delivery controller, loosen clamping screws, replace temperature sensor.

N o t e:
Make sure everything is clean and use new gasket.



Test 4: Measuring voltage, control unit

Connect test adapter KDEP 1160 or KDEP 1165 to connecting lead to control unit.

Connect voltmeter with commercially available test leads to measuring sockets 5 and 6.

Switch on ignition.

Set value: approx. 5 V

Is set value obtained?

N>

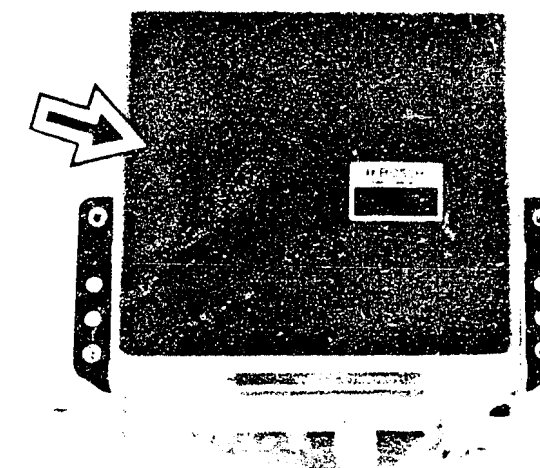
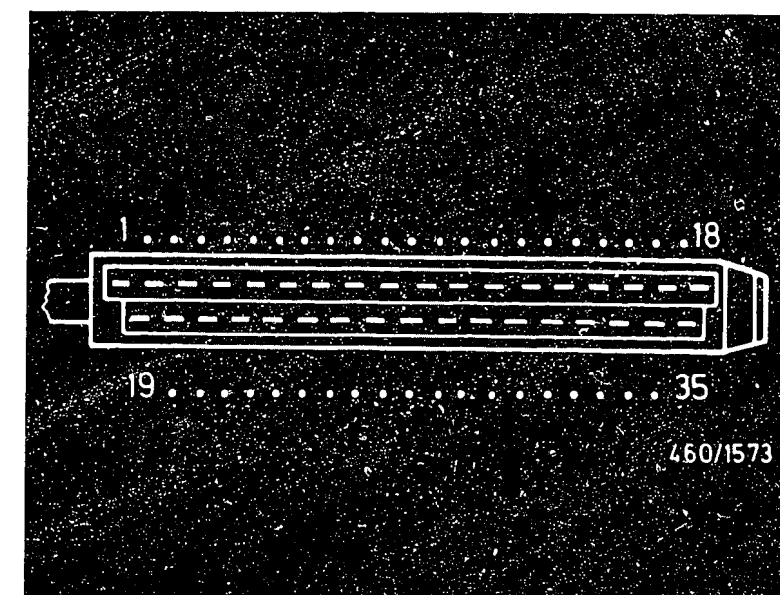
Switch off ignition.

Disconnect control-unit plug (center illustration) and test leads term. 24 and term. 35 to test adapter with test leads KDZS 0004 for open circuit and/or contact resistance.

Bridge measuring sockets 5 and 6.

Set value: approx. 0 Ω

If set value is obtained, replace control unit 1 (lower illustration, arrow).



Return to self-diagnosis test table B13

SELF-DIAGNOSIS TEST PROGRAM (4)

Flashing code: 2.1

Component: Accelerator pedal

Test 1: Internal resistance

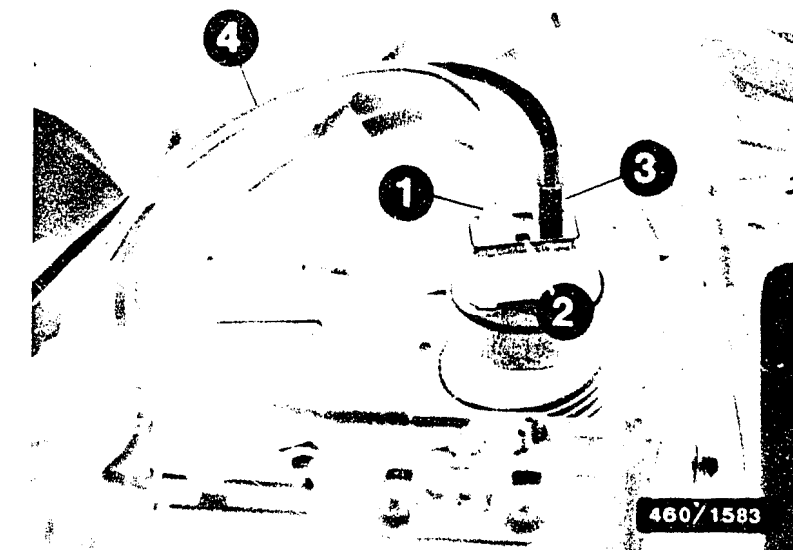
Disconnect cable connector
from accelerator pedal.

Connect ohmmeter with test
leads KDUM 0008 (4) to
accelerator pedal term. 1 and
term. 3 (upper illustration).

Set value: see brief instruc.

Is set value obtained?

If value is outside tolerance
or at infinity Ω , replace
accelerator pedal.



Test 2: Voltage supply

Disconnect cable connector
from accelerator pedal.

Connect voltmeter with test
leads KDZS 0004 to cable
connector term. 1 (-) and
term. 3 (+) (center
illustration).

Switch on ignition.

Set value: 4.8...5.2 V

Is set value obtained?

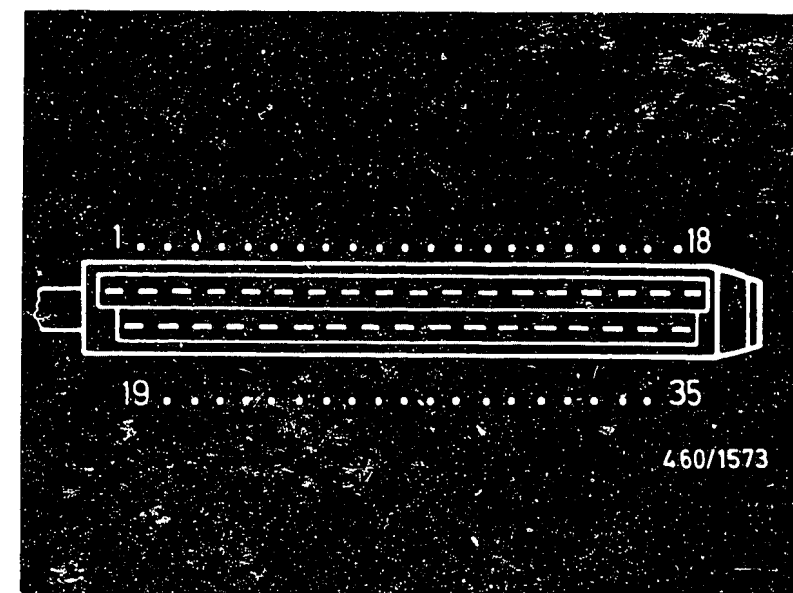
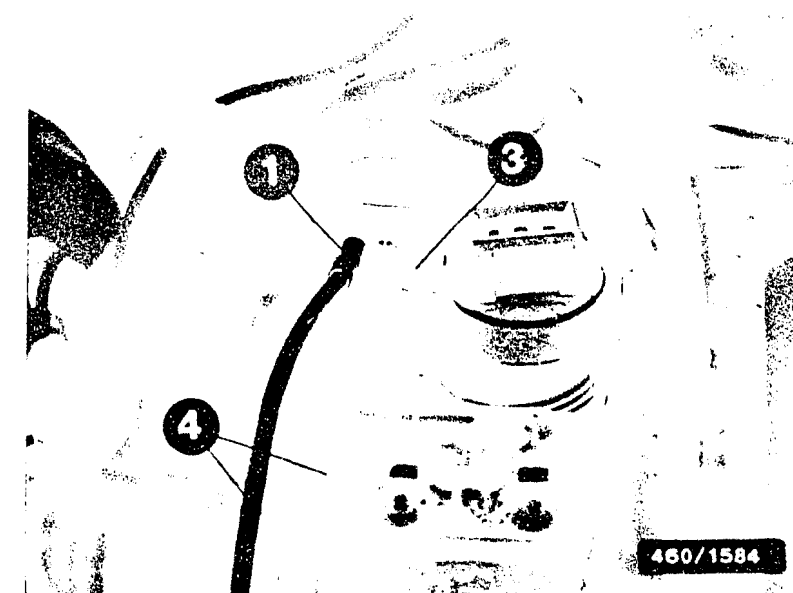
Switch off ignition.

Disconnect control-unit plug
(lower illustration) and test
leads from term. 10 and term. 17
to cable connector of
accelerator pedal with test
leads KDZS 0004 for open
circuit and/or contact resistance.

Bridge leads term. 1 and 3 at
cable connector of accelerator
pedal (center illustration).

Set value: approx. 0 Ω

If set value is obtained,
replace control unit 1.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (4) (CONTINUED)

Test 3 : Voltage signal accelerator pedal

Connect cable connector to
accelerator pedal.
Pull back protective rubber
cap on cable connector. Connect
voltmeter with test leads
KDZS 0004 to cable connector
term. 1 and term. 2 (upper
illustration).

Switch on ignition.
See brief instructions for
set values for idle and
full-load positions.

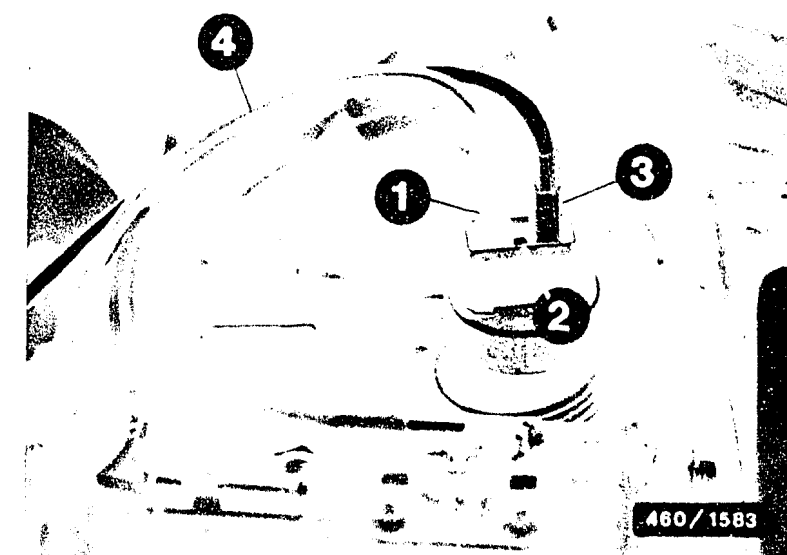
Note:

Determine voltage values by
deflecting the accelerator
pedal.

Voltage values obtained?

N>

Accelerator pedal defective,
replace.



Test 4: Cable connector, control unit to component

Switch off ignition.

Disconnect control-unit plug 1
and test leads term. 10 and
term. 13 to cable connector
of accelerator pedal for
open circuit.

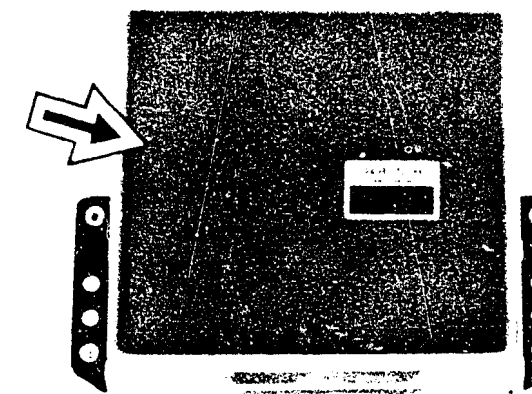
Bridge leads term. 1 and term. 2
at cable connector (accelerator
pedal, upper illustration).

Set value: approx. 0 Ω

Set value obtained?

N>

Eliminate open circuit in lead
(lead term. 13).



Return to self-diagnosis
test table B13

SELF-DIAGNOSIS TEST PROGRAM (5)

Flashing code: 2.2

Component:
Rotational-angle potentiometer
(upper illustration - arrow)

Test 1: Short circuit to ground

Disconnect cable connector
(2, center illustration) from
fuel-injection pump.

Connect test adapter KDEP 1160
or KDEP 1165 (1) to connecting
lead (2, lower illustration)
to fuel-injection pump.

Connect ohmmeter with commer-
cially available test leads
to measuring sockets listed
below:

- 1 and ground
- 2 and ground
- 3 and ground

Set value: $> 1 \text{ M } \Omega$

Is set value obtained?

Test 2: Short circuit

Connect ohmmeter with commer-
cially available test leads
to measuring sockets 2 and 7.

Set value: $> 1 \text{ M } \Omega$

Is set value obtained?

Continued on next picture page

Remove closing cover from
delivery controller.

Test terminal posts and con-
ductors for short circuit to
ground.

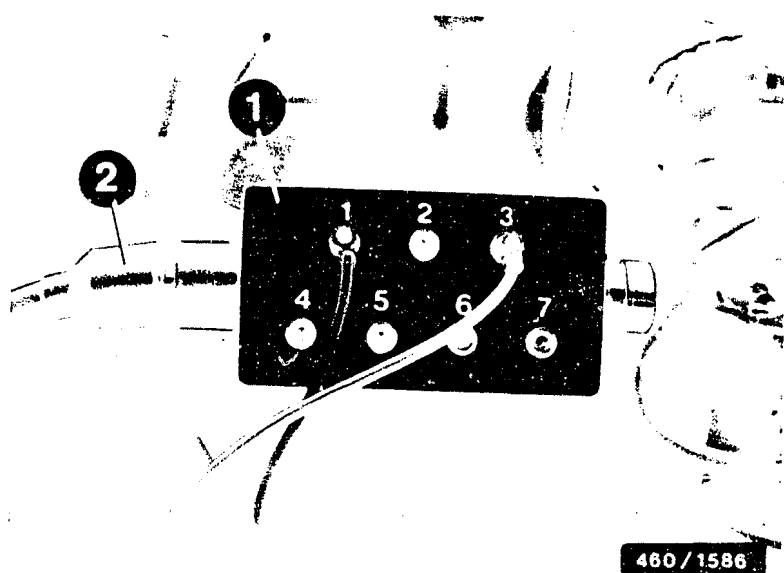
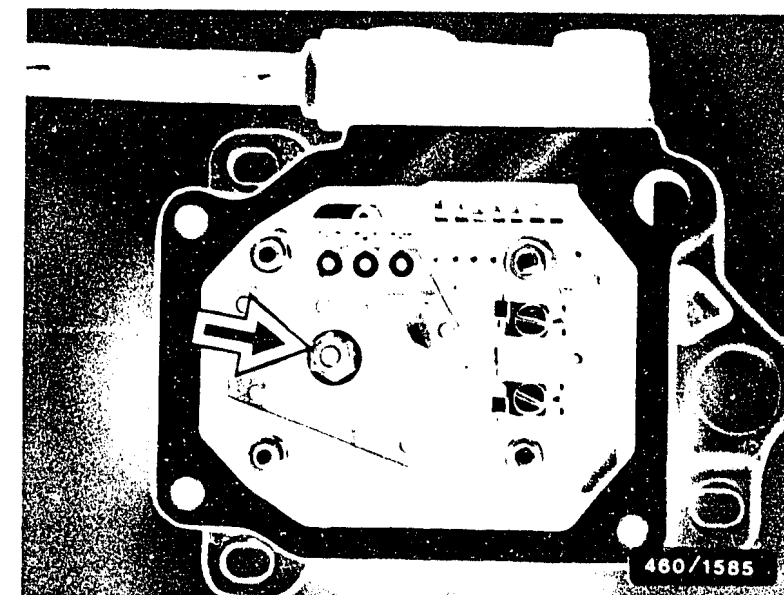
If necessary, remove fuel-
injection pump and replace
delivery controller.

Note:
Potentiometer cannot be
exchanged separately.

Remove closing cover from
delivery controller.

Test whether terminal post or
conductors are touching or
make electrical contact with
foreign bodies.

Eliminate fault, remove fuel-
injection pump if necessary,
and replace delivery controller.



SELF-DIAGNOSIS TEST PROGRAM (5) (CONTINUED)

Test 3: Resistance, potentiometer path
(upper illustration)

Connect ohmmeter with commercially available test leads to measuring sockets 2 and 3.

Set value: see brief instruc.

Is set value obtained?

Rotational-angle potentiometer defective, remove fuel-injection pump. Replace delivery controller.

Test 4: Resistance wiper path
(upper illustration)

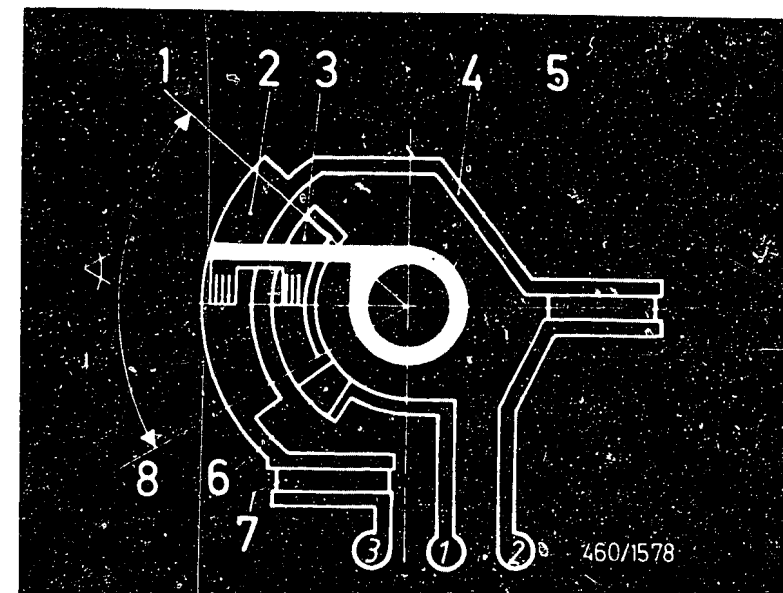
Connect ohmmeter with commercially available test leads to measuring sockets 1 and 3.

Set value: see brief instruc.

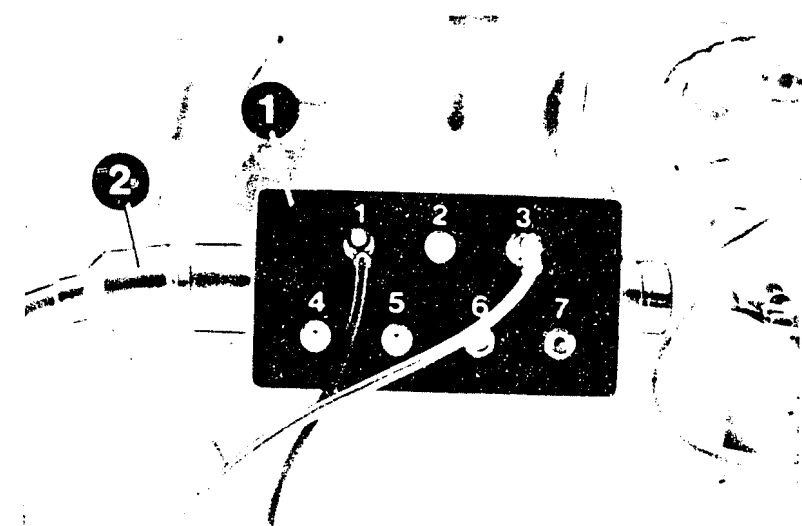
Is set value obtained?

Resistors, potentiometer path/wiper path or wiper defective.

Remove fuel-injection pump. Replace delivery controller.



- 1 = Excess-fuel stop
- 2 = Potentiometer path
- 3 = Wiper path
- 4 = Conductor
- 5 = Wiper
- 6 = Series resistor
- 7 = Trimmer resistors
- 8 = Shutoff stop



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (5) (CONTINUED)

Test 5: Voltage supply

Connect test adapter KDEP 1160 or KDEP 1165 (1) to connecting lead to control unit (3, upper illustration).

Connect voltmeter with commercially available test leads to measuring sockets 2 (+) and 3 (-) (lower illustration).

Switch on ignition.

Set value: 4.80...5.20 V

Is set value obtained?

N>

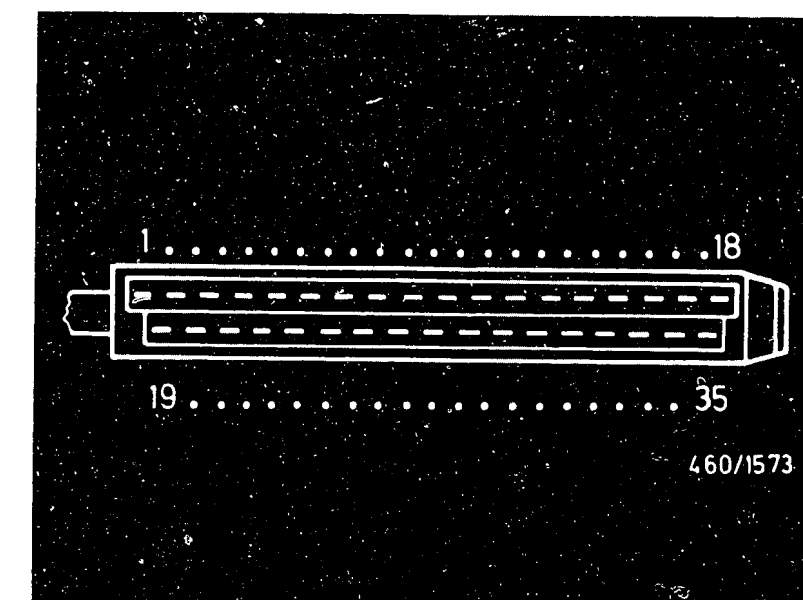
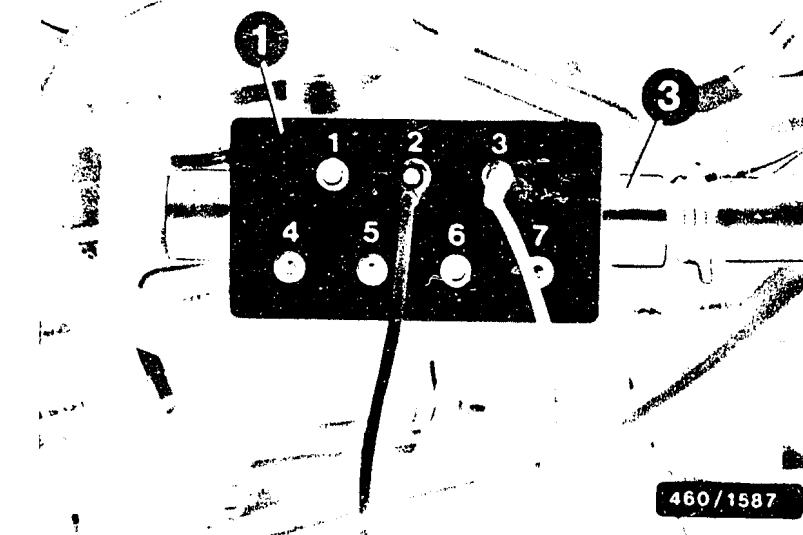
Switch off ignition.

Disconnect control-unit plug 1 and test leads from term. 10 and term. 29 to test adapter with test leads KDZS 0004 for open circuit and/or contact resistance.

Bridge measuring sockets 2 and 3 (upper illustration).

Set value: approx. 0 Ω

If set value is obtained, replace control unit 1.



Test 6: Voltage-signal potentiometer

Connect both connecting leads (2 and 3) to test adapter KDEP 1160 or KDEP 1165 (1). Connect voltmeter with commercially available test leads to measuring sockets 1 and 3. Switch on ignition. Disconnect cable connector from coolant-temperature sensor and needle-movement sensor. Set value: see brief instruc. Connect cable connector to needle-movement sensor. Set value: see brief instruc.

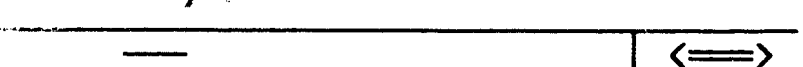
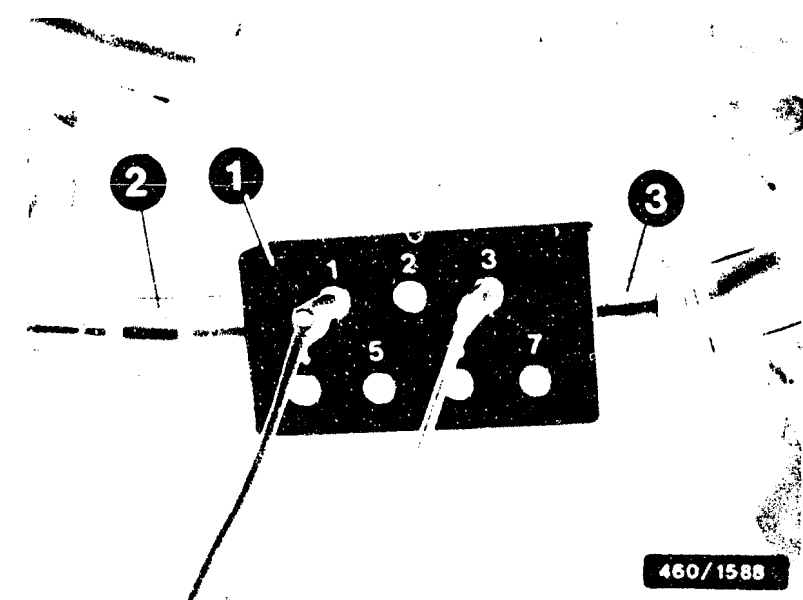
Are set values obtained?

N>

Remove closing cover from delivery controller.

Check whether potentiometer reaches shutoff and starting positions when delivery controller is deflected.

If potentiometer is deflected, remove fuel-injection pump and replace delivery controller.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (5) (CONTINUED)

Test 7: Cable connection,
control unit to
component

Switch off ignition.

Connect test adapter KDEP 1160
or KDEP 1165 to connecting
lead to control unit.

Bridge measuring sockets 1
and 3 at test adapter.

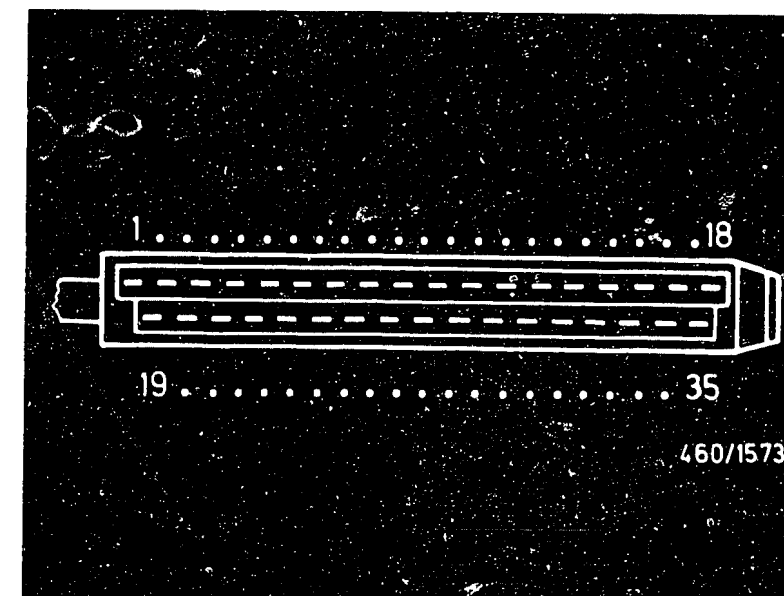
Disconnect control-unit plug 1
(lower illustration) and test
leads from term. 6 and term. 10
(upper illustration) to test
adapter with test leads KDZS
0004 for open circuit and/or
contact resistance.

Set value: approx. 0 Ω

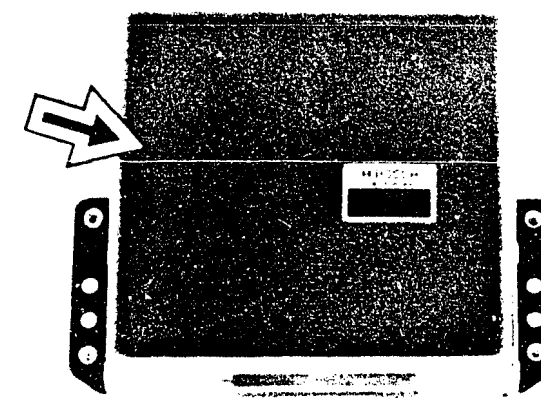
Is set value obtained?

Eliminate open circuit in
lead and/or contact resistance.

Return to self-diagnosis
test table B15



Arrow = Delivery and road-
speed control unit
(Designated control unit 1
in these trouble-shooting
instructions)
Installation position:
Behind footrest on
passenger's side



SELF-DIAGNOSIS TEST PROGRAM (6)

Flashing code: 2.3

Component:
Delivery controller
(upper illustration - arrow)

Test 1: Short circuit to ground

Disconnect cable connector
(2, lower illustration) from
fuel-injection pump.

Connect test adapter KDEP 1160
or KDEP 1165 (1) to connecting
lead (2) to fuel-injection
pump (center illustration).

Connect ohmmeter with commer-
cially available test leads
to measuring sockets listed
below (center illustration).

4 and ground

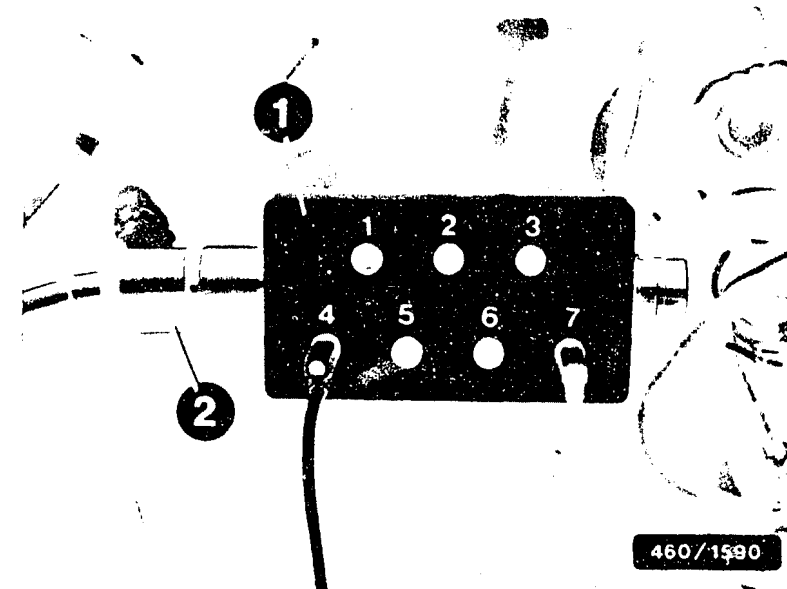
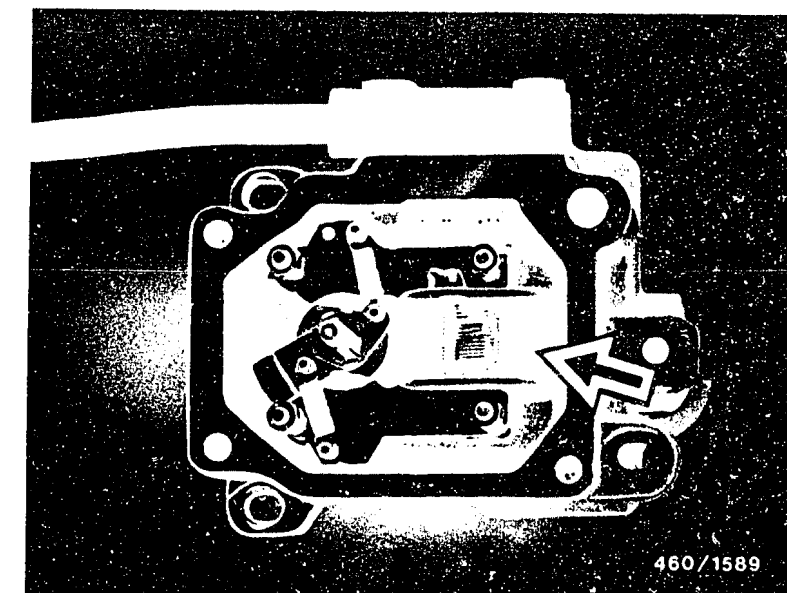
7 and ground

Set value: $> 1 \text{ M } \Omega$

Is set value obtained?

N>

If test specification is not
obtained, remove fuel-injection
pump and replace delivery
controller.



Test 2: Internal resistance

Connect ohmmeter with commer-
cially available test leads to
measuring sockets 4 and 7.

Set value: see brief instruc.

Is set value obtained?

N>

If test specification is not
obtained, remove fuel-injection
pump and replace delivery
controller.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (6) (CONTINUED)

Test 3:
Cable conenction, control unit
to component

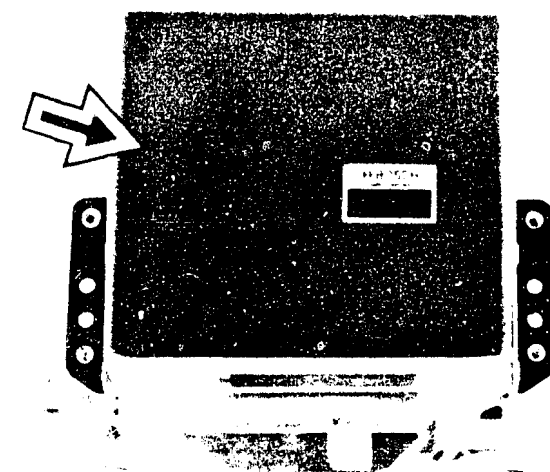
Connect test adapter KDEP 1160
or KDEP 1165 to connecting
lead to control unit.
Bridge measuring sockets 4 and
7 at test adapter.
Disconnect control-unit plug
1 (upper illustration) and
test leads from term. 1 and
term. 21 (center illustration)
to test adapter with test
leads KDZS 0004 for
open circuit and/or contact
resistance.

Set value: approx. 0 Ω

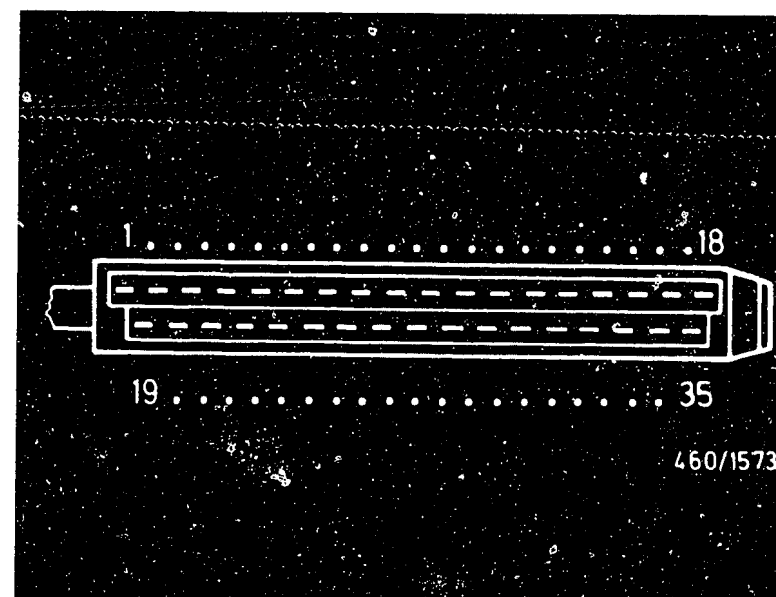
Is set value obatined?

N>

Eliminate open circuit in lead
and/or contact resistance.



460/1574



460/1573

Test 4: Voltage supply

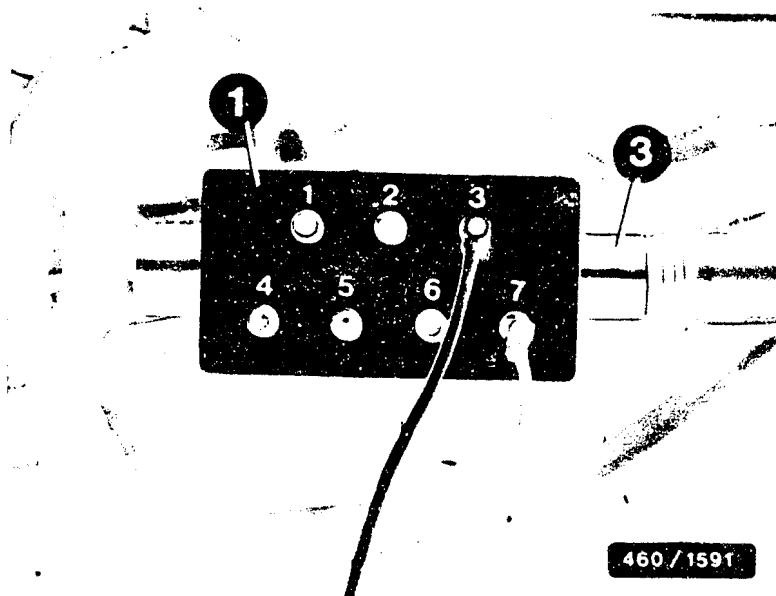
Connect test adapter KDEP 1160
or KDEP 1165 to connecting lead
to control unit.
Connect voltmeter with commer-
cially available test leads
to measuring sockets 3 (-) and
7 (+) (lower illustration).
Connect control unit.
Switch on ignition.

Set value: 8.0...14.5 V

Is set value obtained?

N>

Control unit 1 (lower illus-
tration, arrow) defective, replace.



460/1591

Return to self-diagnosis
test table B17

SELF-DIAGNOSIS TEST PROGRAM (7)

Flashing code: 2.4

Component:
Speed sensor
(upper illustration - arrow)

Test 1: Internal resistance

Disconnect cable connector
from speed sensor.

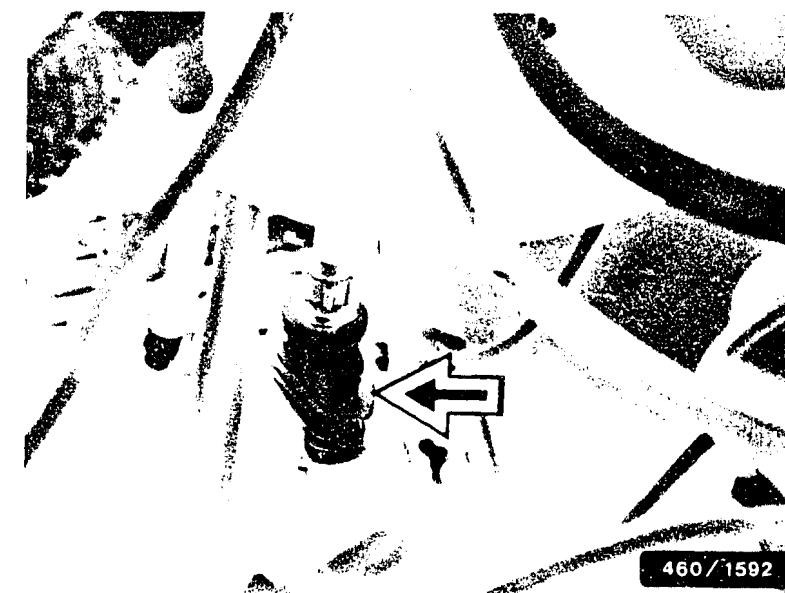
Connect ohmmeter with commercially available test leads and test prods to both terminal posts of speed sensor.

Set value: see brief instruc.

Is set value obtained?

N>

Speed sensor defective, replace.



460/1592

Test 2: Measuring voltage,
control unit

Connect voltmeter with test leads KDZS 0004 to cable connector.

Switch on ignition.

Set value: approx. 5 V

Is set value obtained?

N>

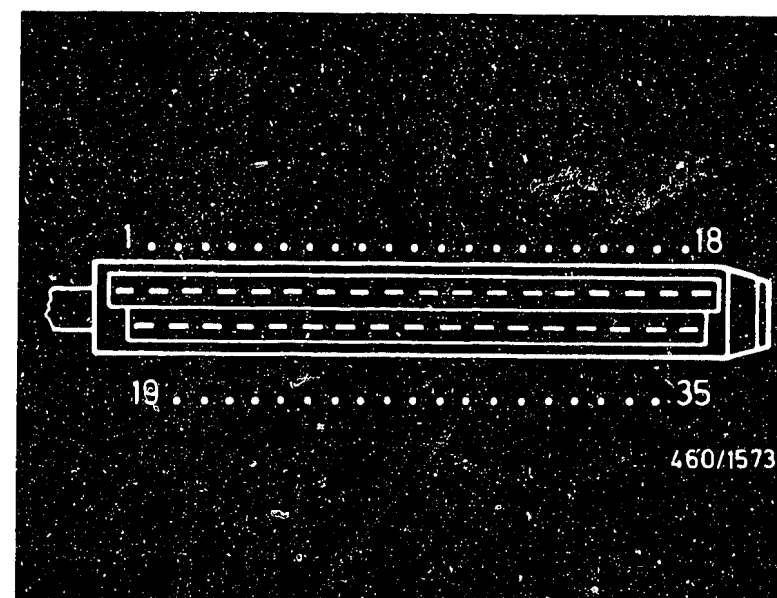
Switch off ignition.

Disconnect control-unit plug 1 (lower illustration) and test leads from term. 9 and term. 35 (center illustration) to speed sensor with test leads KDZS 0004 for open circuit and/or contact resistance.

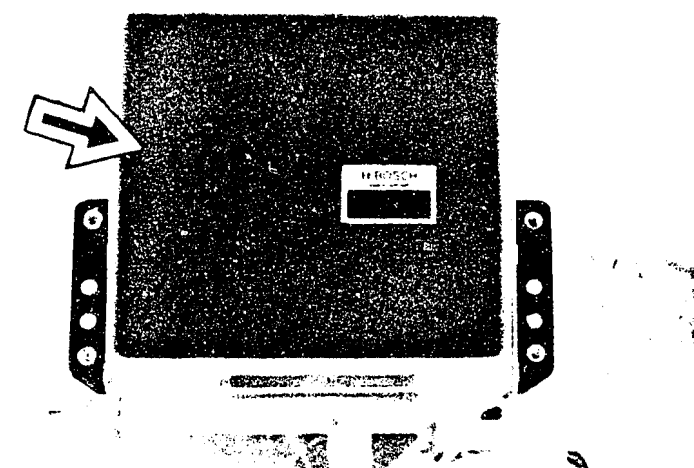
Bridge leads at cable connector (speed sensor).

Set value: approx. 0 Ω

If set value is obtained, replace control unit 1.



460/1573



460/1574

Return to self-diagnosis
test table B17

SELF-DIAGNOSIS TEST PROGRAM (8)

Flashing code : 2.5

Component:
Pressure transducer, road-speed
control (upper illustration,
arrow)

Test 1: Internal resistance

Disconnect cable connector
from pressure transducer.

Connect ohmmeter with commer-
cially available test leads
to both terminal posts
of pressure transducer.

Set value at
approx. $+20^{\circ}\text{C} = 5.0 \dots 6.0 \Omega$

Is set value obtained?

N>

Pressure transducer defective,
replace.



460 / 1593

Test 2: Measuring voltage,
control unit

Connect voltmeter with commer-
cially available test leads
to both connectors.

Switch on ignition.

Set value: approx. 12 V

Is set value obtained?

N>

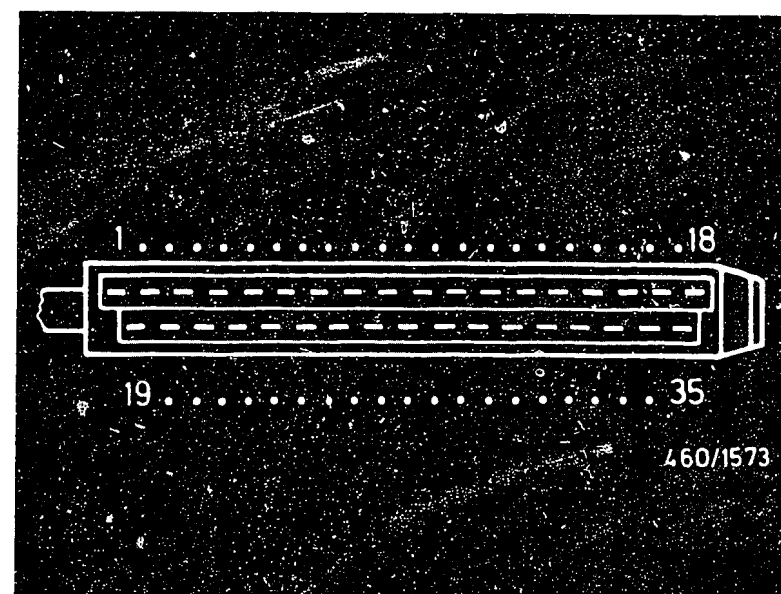
Switch off ignition.

Disconnect control-unit plug 1
(lower illustration) and test
leads from term. 1 and term. 25
(center illustration) to
pressure transducer with test
leads KDZS 0004 for open circuit
and/or contact resistance.

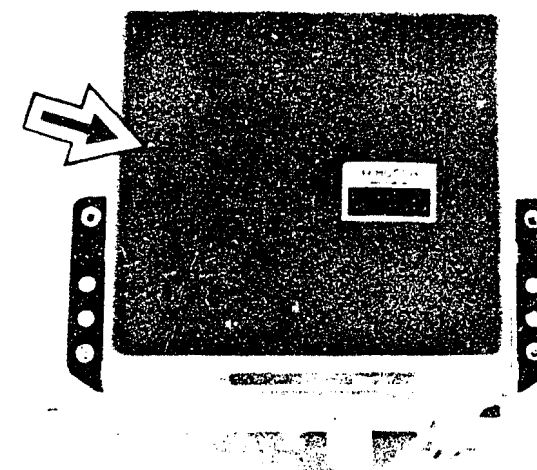
Bridge leads at cable connector
or pressure transducer.

Set value: approx. 0Ω

If set value is obtained,
replace control unit 1 (lower
illustration - arrow).



460/1573



460/1574

Return to self-diagnosis
test table B17

C25

<=>

C26

<=>

SELF-DIAGNOSIS TEST PROGRAM (8) (CONTINUED)

Test 3: Vacuum control, pressure transducer

Connect vacuum gauge to
connection 2 (see upper
illustration).

Connect cable connector to
control unit and component.

Drive vehicle on a chassis
dynamometer at a speed
exceeding 40 km/h.

Does pressure gauge indicate
vacuum?

N>

Test vacuum supply at connection
1.

If no vacuum is present, test
gear-shift valve starting at
Coordinate E25.

If vacuum supply is present,
replace pressure transducer.



Test 4: Vacuum actuation, aneroid capsule of speed control (lower illustration, arrow)

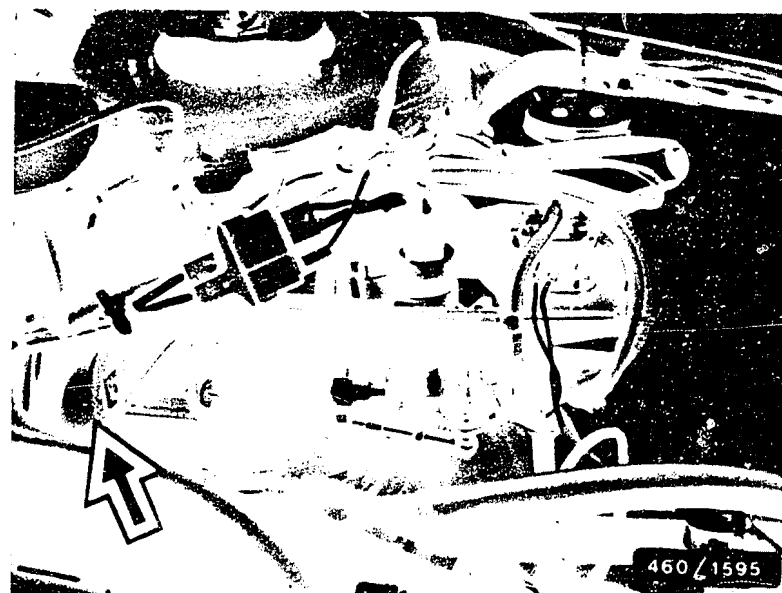
Increase vehicle speed to
above 40 km/h, switch on road-
speed control.

Is accelerator pedal deflected
by operation of aneroid
capsule?

N>

Test vacuum hose for
leaks.

If there are no leaks, replace
aneroid capsule.



Return to self-diagnosis
test table B19

SELF-DIAGNOSIS TEST PROGRAM (9)

Flashing code : 3.1

Component:
Atmospheric-pressure sensor
(upper illustration, arrow)

Test 1: Voltage supply

Disconnect cable connector
from atmospheric-pressure sensor.

Connect voltmeter with test
leads KDZS 0004 to cable
connector term. 1 (-) and
term. 3 (+) (upper
illustration).

Switch on ignition.

Set value: 4.80...5.20 V

Is set value obtained?

N>

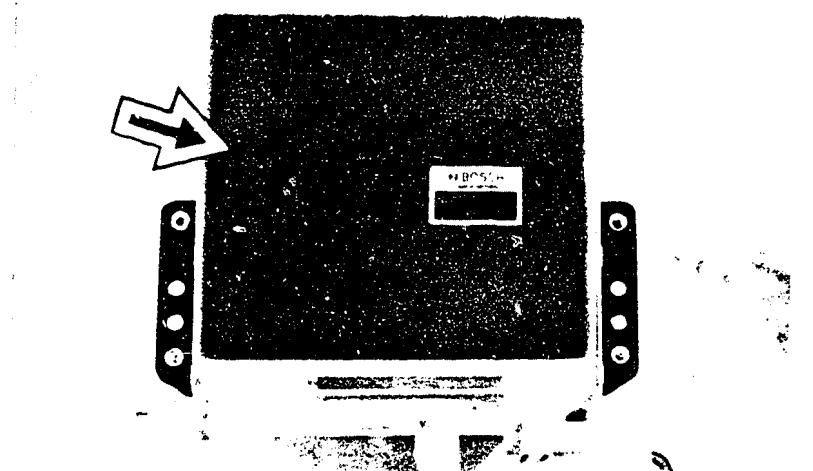
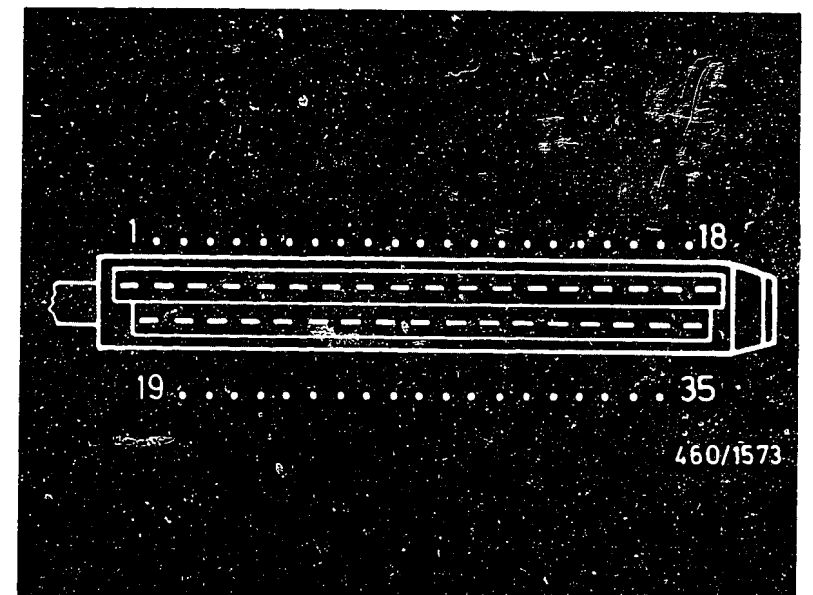
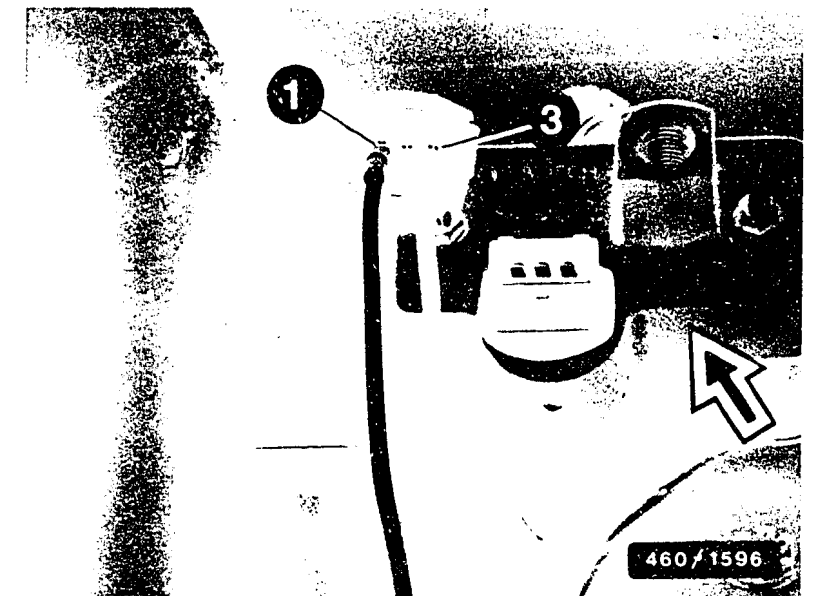
Switch off ignition.

Disconnect control-unit plug 1
and test leads from term. 28
and term. 35 (center illus-
tration) to atmospheric-pressure
sensor for open circuit and/or
contact resistance.

Bridge leads at cable connector
of atmospheric-pressure sensor.

Set value: approx. 0 Ω

If set value is obtained,
replace control unit 1 (lower
illustration, arrow).



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (9) (CONTINUED)

Test 2: Voltage signal,
atmospheric-
pressure sensor

N>

Atmospheric-pressure sensor
defective, replace.

Connect cable connector to
atmospheric-pressure sensor.
Pull back rubber cap on cable
connector.
Connect voltmeter with test
leads KDZS 0004 to cable
connector term. 1 and term. 2.
Measure atmospheric pressure
(barometric pressure).
Switch on ignition.

Set value: see characteristic
curve (center illus.)
Is set value obtained?

Test 3: Cable connection,
control unit -
component

N>

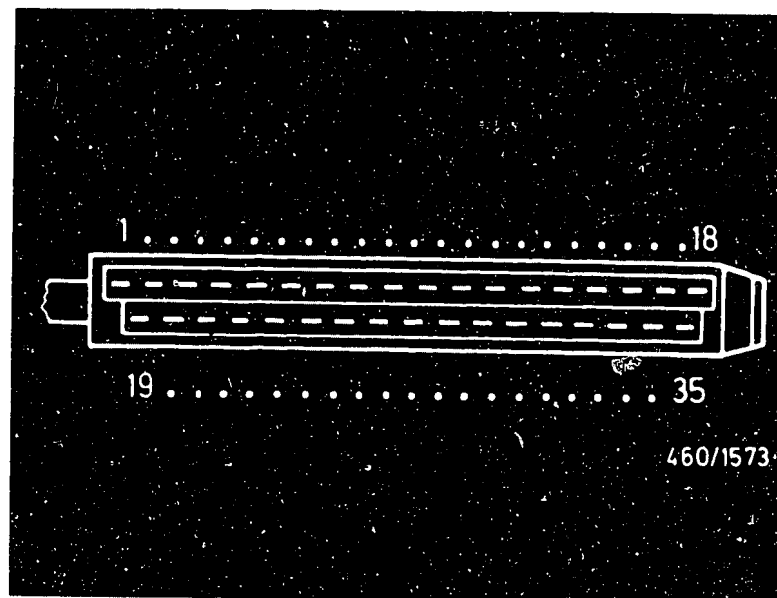
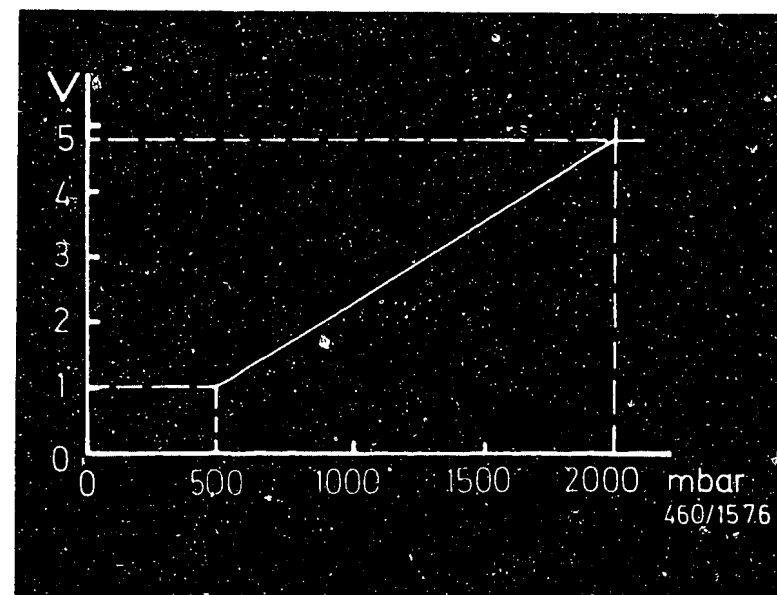
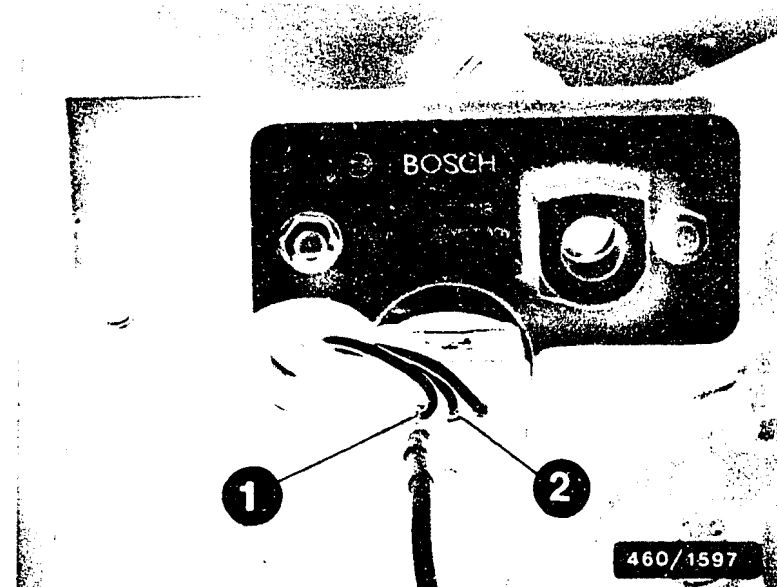
Eliminate open circuit in
lead.

Switch off ignition.
Disconnect control-unit plug 1
and test leads from term. 28
and term. 34 (lower illustration)
to cable connector of
atmospheric-pressure sensor for
open circuit.
Bridge leads term. 1 and term. 2
at cable connector of
atmospheric-pressure sensor.

Set value: approx. 0 Ω

Is set value obtained?

Return to self-diagnosis
test table B19



SELF-DIAGNOSIS TEST PROGRAM (10)

Flashing code : 3.3

Component:
Air-flow sensor
(upper illustration, arrow)

Test 1: Overall resistance

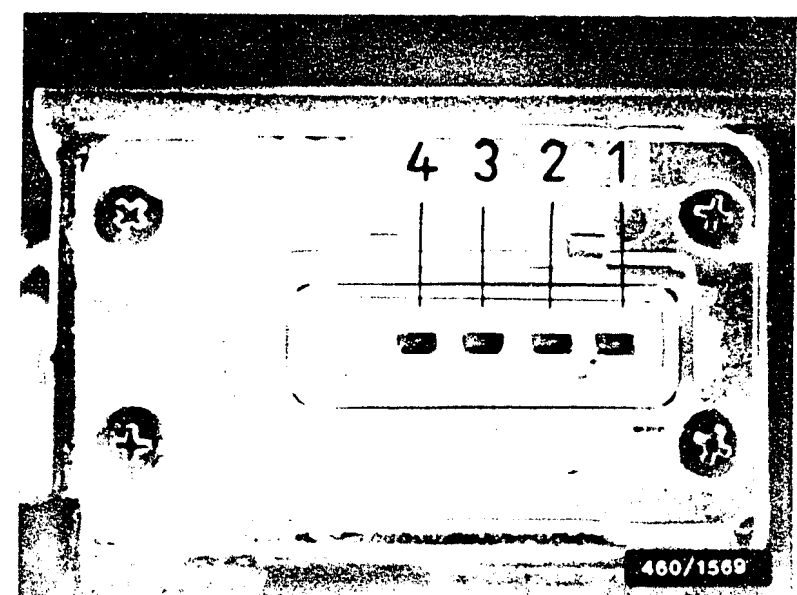
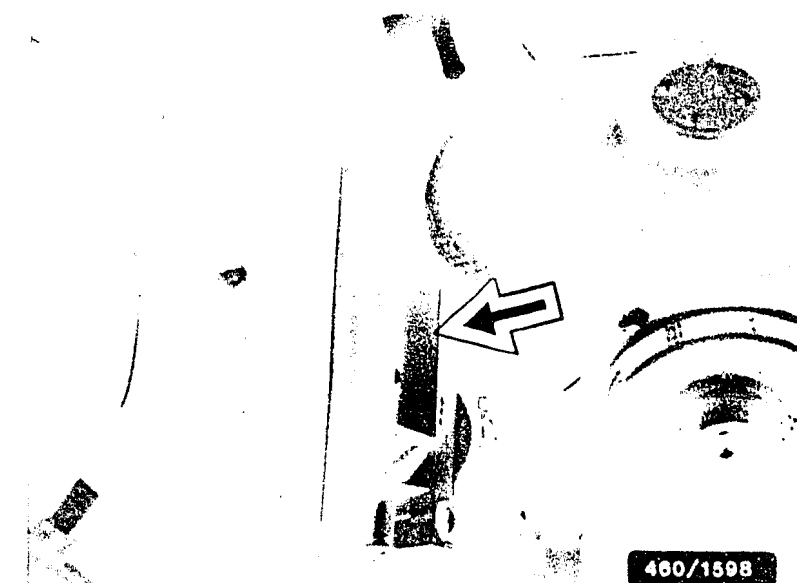
Disconnect cable connector
from air-flow sensor.

Connect ohmmeter with test
leads KDUM 0008 to air-flow
sensor term. 3 and term. 4
(see illustration).

Set value: see brief instruc.

Is set value obtained?

Air-flow sensor defective,
replace.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (10) (CONTINUED)

Test 2: Voltage supply

Connect voltmeter with test leads KDZS 0004 to cable connector term. 3 (+) and 4 (-), (Upper illustration).
Switch on ignition.

Set value: 4.8...5.2 V

Is set value obtained?

N>

Switch off ignition.

Disconnect control-unit plug 2 (lower illustration) and test leads from term. 4 and term. 24 (center illustration) to cable connector of air-flow sensor for open circuit and/or contact resistance.

Bridge leads term. 3 and term. 4 at cable connector of air-flow sensor.

Set value: approx. 0 Ω

If set value is obtained, replace control unit 2.

Test 3: Voltage signal, air-flow sensor

Connect cable connector to air-flow sensor.

Pull back rubber cap on cable connector.

Connect voltmeter with test leads KDZS 0004 to cable connector term. 2 and term. 4.

Switch on ignition.

Set value: see brief instruc.

Deflect air-flow sensor flap.

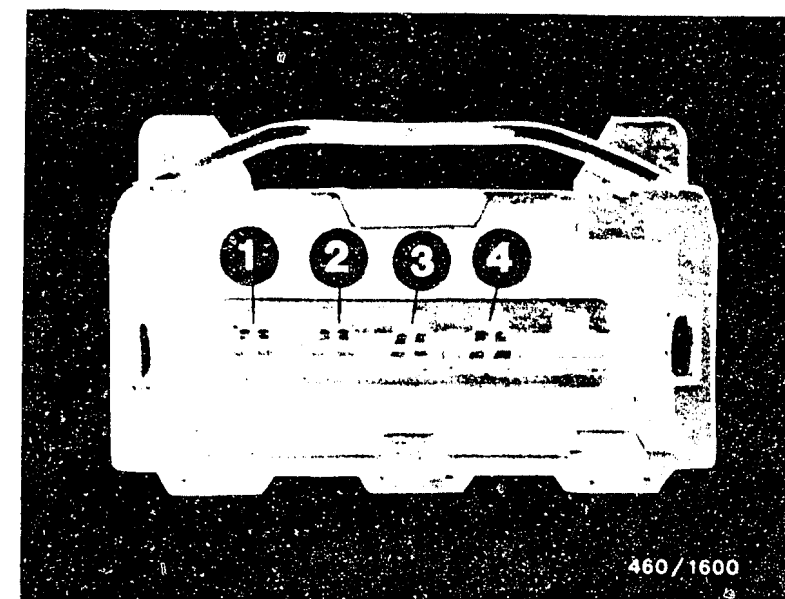
Set value: see brief instruc.

Is set value obtained?

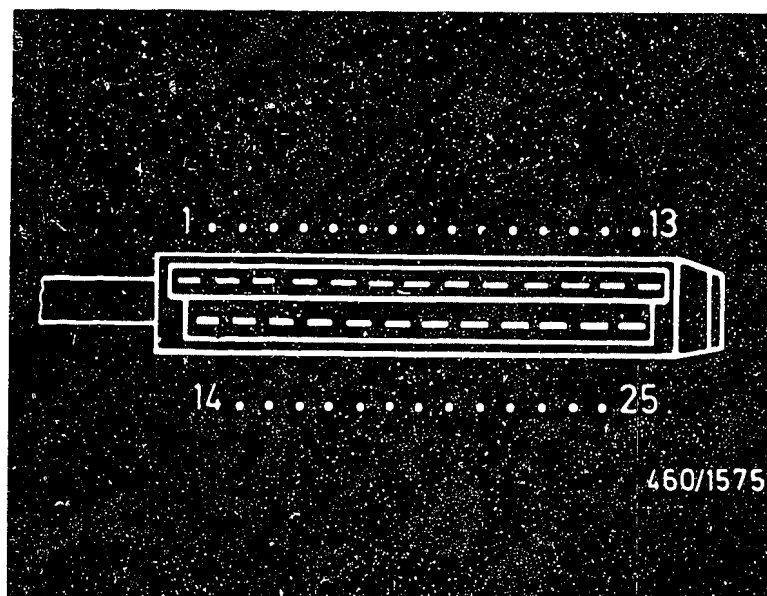
N>

Air-flow sensor defective, replace.

Continued on next picture page



460/1600



460/1575

SELF-DIAGNOSIS TEST PROGRAM (10) (CONTINUED)

V

Test 4:
Cable connection, control unit
to component:

N>

Eliminate open circuit in
lead term. 10.

Switch off ignition.

Disconnect control-unit plug 2
and test leads from term. 4
and term. 10 (upper illus-
tration) to cable connector
of air-flow sensor for open
circuit.

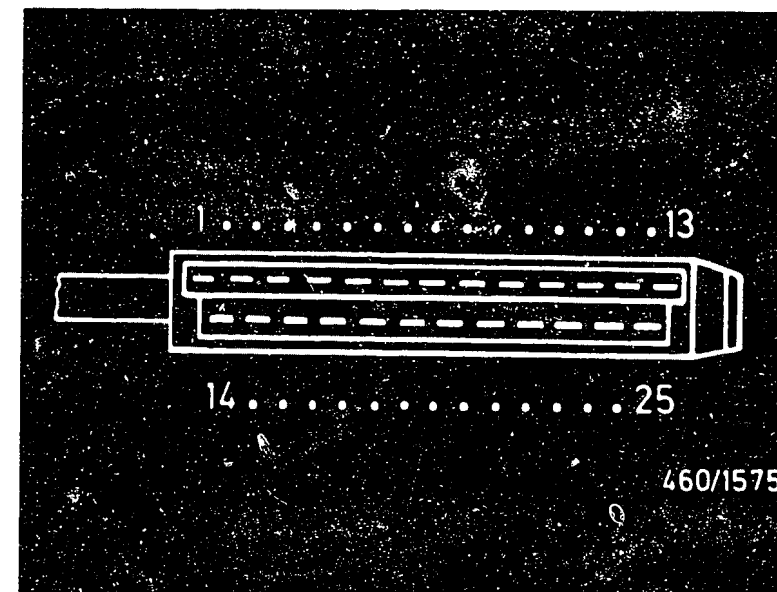
Bridge leads term. 2 and
term. 4 at cable connector
of air-flow sensor.

Set value: approx. 0 Ω

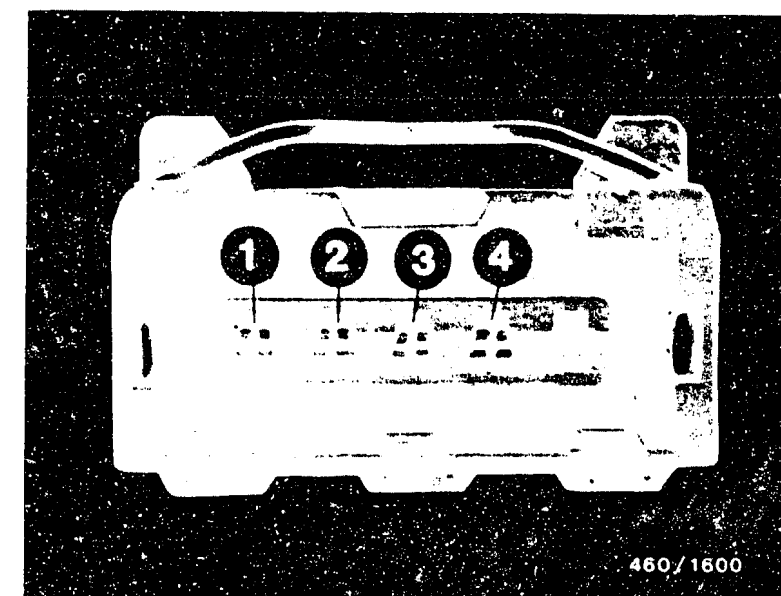
Is set value obtained?

V

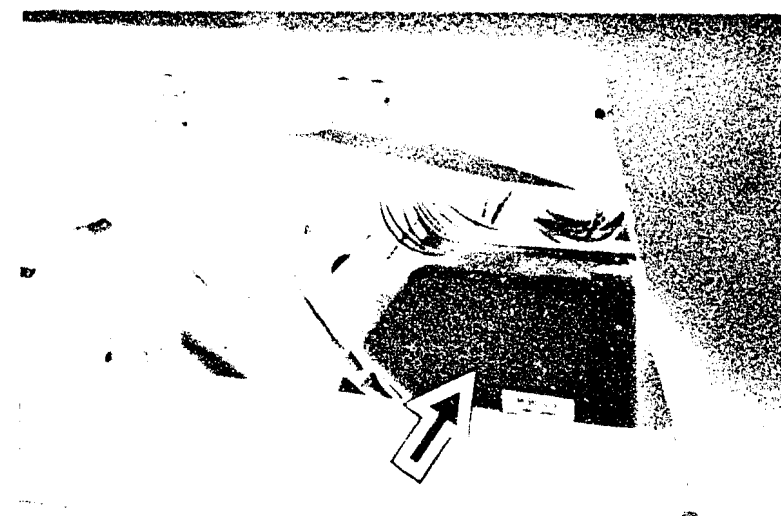
Continued on next picture page



460/1575



460/1600



460/1601

SELF-DIAGNOSIS TEST PROGRAM (10) (CONTINUED)

Test 5:
Potentiometer test
(Noise test)

N>

Air-flow sensor defective,
replace.

For testing, use Motortester.

Press special input and
10 ms buttons.

Pull back rubber cap on cable
connector of air-flow
sensor.

Connect Motortester with test
leads KDZS 0004 to cable
connector term. 2 and term. 4
(upper illustration).

Switch on ignition.

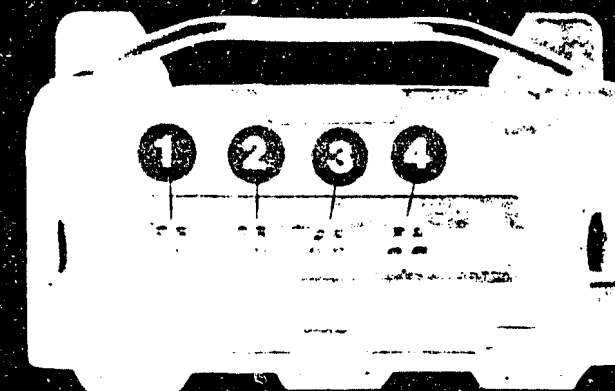
Deflect sensor flap of air-flow
sensor violently several
times (center illustration).

If the air-flow sensor is in
good condition, a stroke signal
without interruptions must be
visible on the oscilloscope.

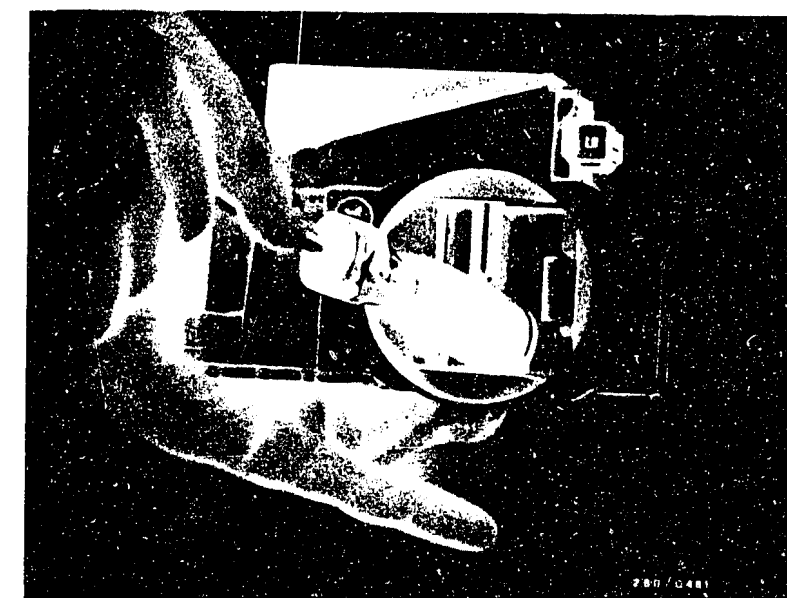
If the air-flow sensor is
defective, a noise signal
similar to that illustrated
on the right appears.

Is signal pattern O.K.?

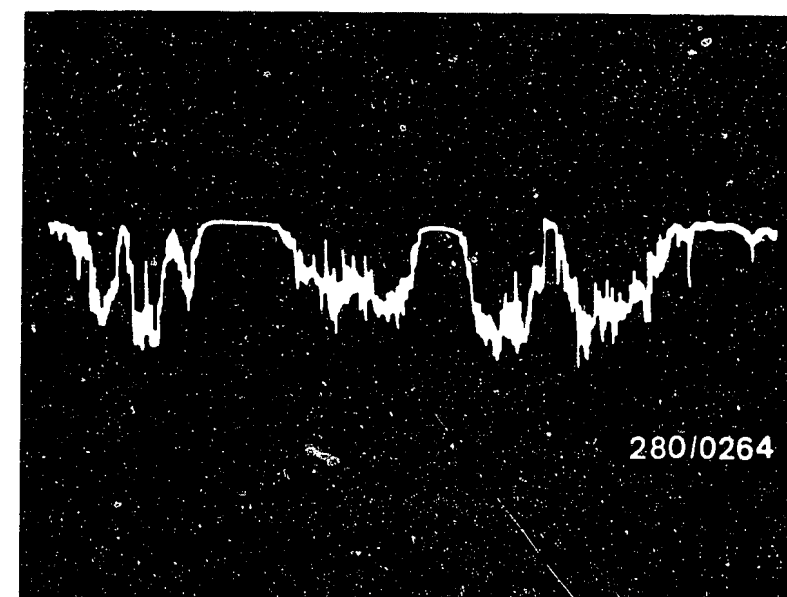
Return to self-diagnosis
test table B19



480/1600



280/0481



280/0264

SELF-DIAGNOSIS TEST PROGRAM (11)

Flashing code: 3.4

Component:
Pres. trans., exh.gas recirc.
(upper illustration, arrow)

Test 1: Internal resistance

Disconenct cable connector
from pressure transducer.

Connect ohmmeter with commer-
cially available test leads
to both terminal posts of
the pressure transducer.

Set value:
at approx. +20° C = 5.0...6.0 Ω

Is set value obtained?

N>

Pressure transducer defective,
replace.

Test 2: Measuring voltage,
control unit

Connect voltmeter with commer-
cially available test leads
to both connectors.

Switch on ignition.

Set value: approx. 12 V

Is set value obtained?

N>

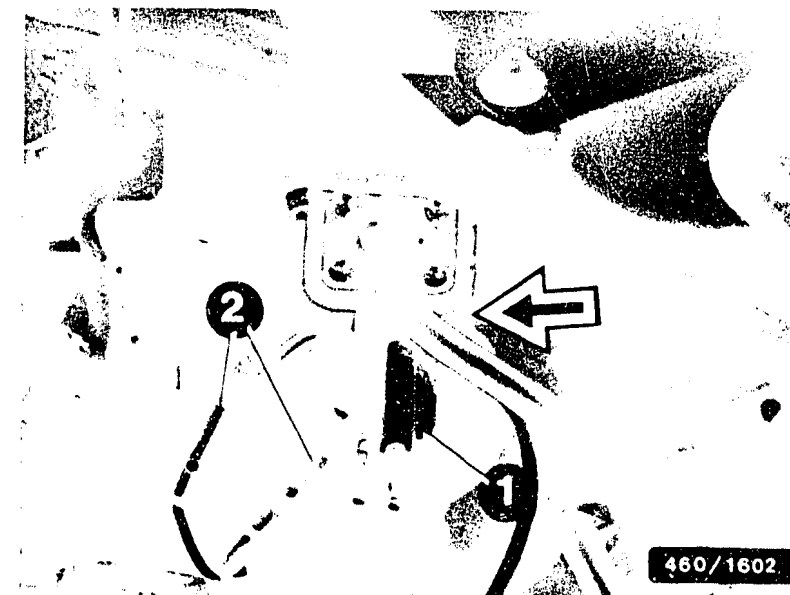
Switch off ignition.

Disconnect control-unit plug 2
(lower illustration) and test
leads from term. 1 and term. 7
(center illustration) to
pressure transducer with test
leads KDZS 0004 for open circuit
and/or contact resistance.

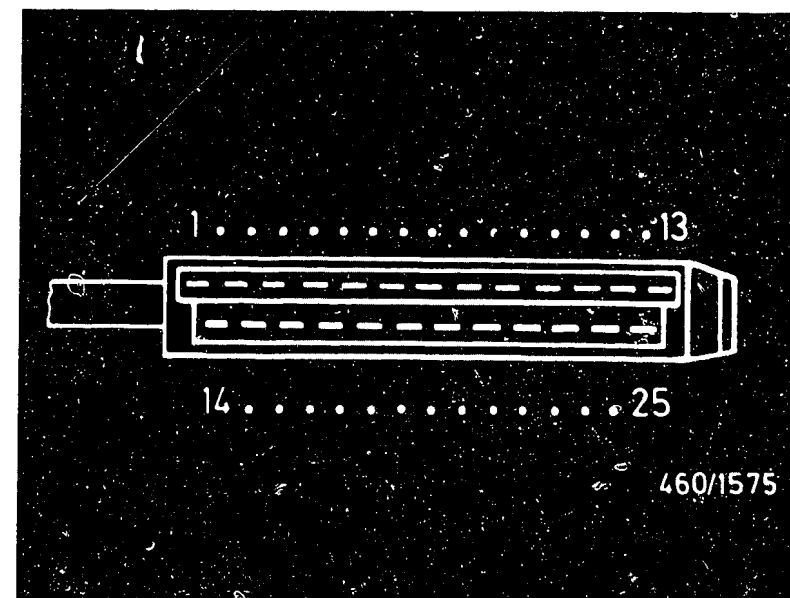
Bridge leads at cable connector
of pressure transducer.

Set value: approx. 0 Ω

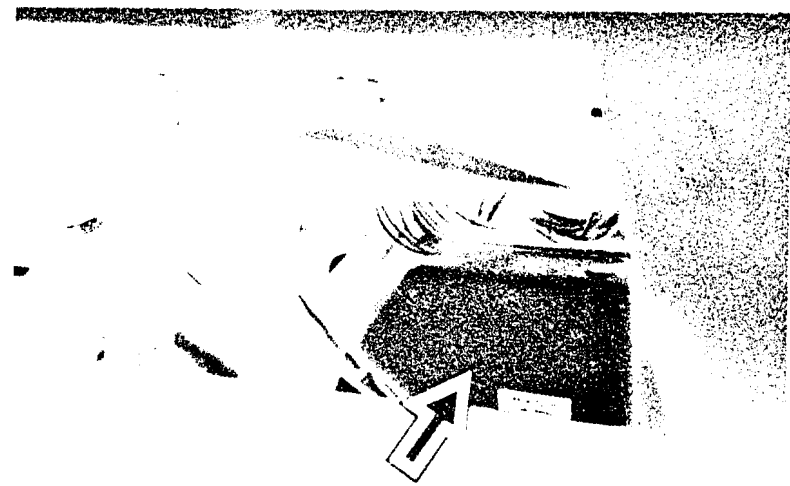
If set value is obtained,
replace control unit 2.



460/1602



460/1575



460/1601

Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (11) (CONTINUED)

Test 3: Actuation
on/off ratio

N>

Control unit 2 defective,
replace.

Connect pocket tester with
commercially available test
leads to both terminal posts
of the pressure transducer
(see illustration).

Adjust measuring range for
dwell angle and run engine
at idle speed.

Set value: see brief instruc.

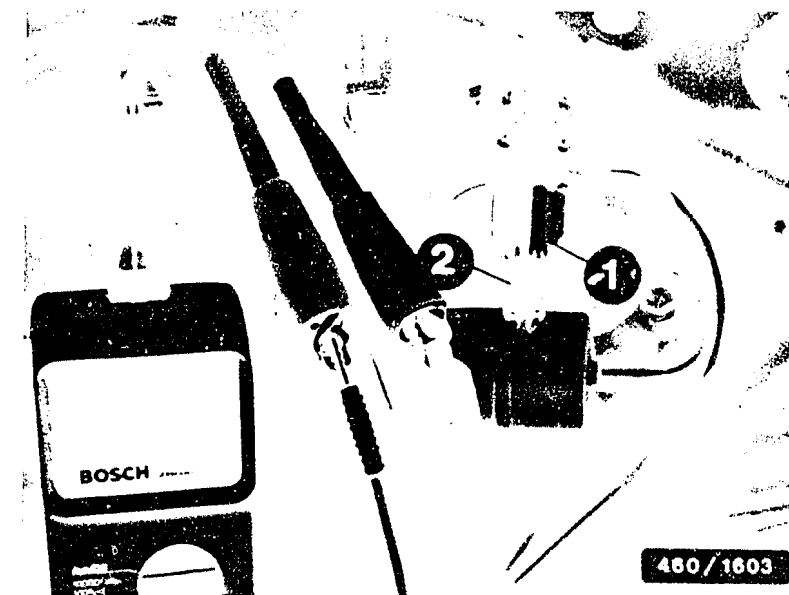
Coolant-water temperature
approx. + 80° C.

Read off the on/off ratio
from the pocket tester.

Disconnect cable connector
from coolant-temperature sensor
or air-flow sensor.

Set value: see brief instruc.

Does the on/off ratio of one
of the components change when
cable connector is disconnected?



- 1 = Test leads
(commercially available)
2 = Connecting leads,
pressure transducer

Return to self-diagnosis
test table B19

SELF-DIAGNOSIS TEST PROGRAM (12)

Flashing code: 4.1

Component:
Speed sensor
(upper illustration, arrow)

Test 1: Short circuit to ground

Disconnect multiple butt
connector from speed sensor
(center illustration, arrow).

Connect ohmmeter with commer-
cially available test leads
and test prods to one terminal
post and ground in each case.

Set value: > 1 M Ω

Is set value obtained?

N>

Speed sensor defective,
replace.

Test 2: Internal resistance

Connect ohmmeter with commer-
cially available test leads
to both terminal posts of
the multiple butt connector.

Set value: see brief instruc.

Is set value obtained?

N>

Speed sensor defective,
replace.

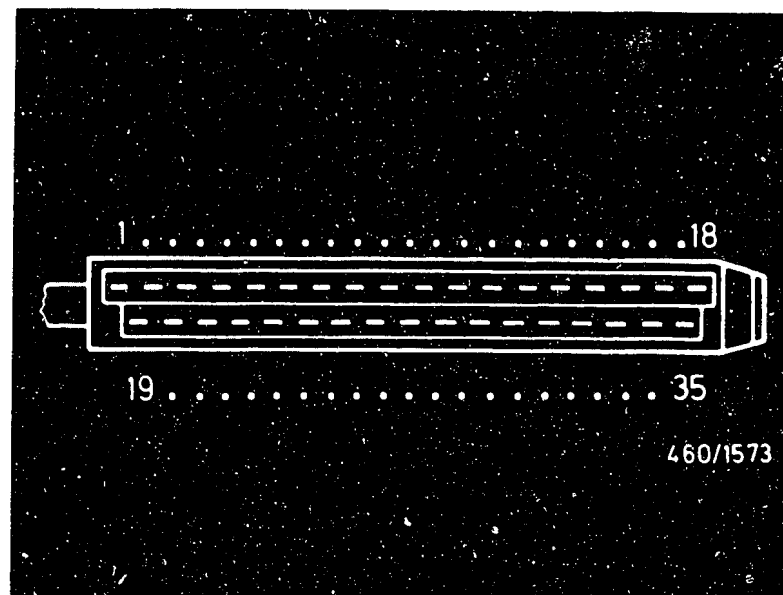
Continued on next picture page



460/1559



460/1604



460/1573

SELF-DIAGNOSIS TEST PROGRAM (12) (CONTINUED)

Test 3: Cable connection,
control unit
to component

N>

Eliminate open circuit in lead
and/or contact resistance.

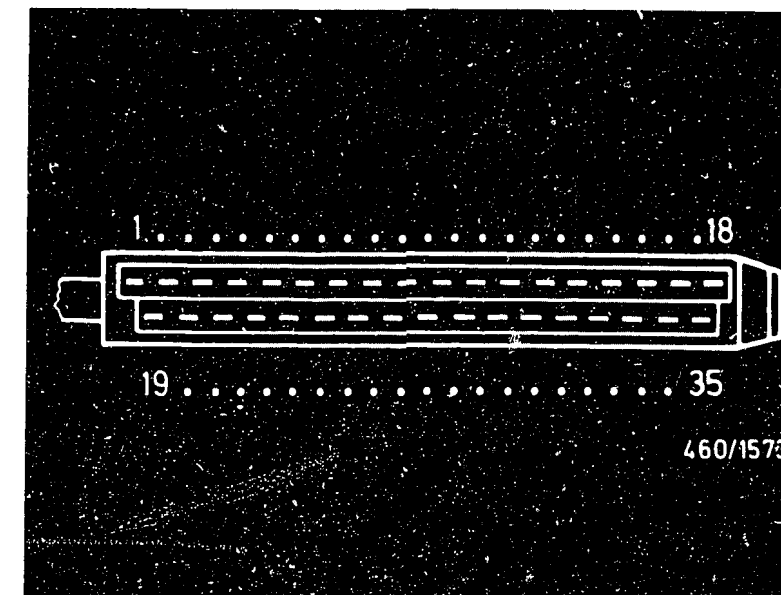
Switch on ignition.

Disconnect control-unit plug 1
and test leads from term. 31
and term. 35 (upper illustration)
to multiple butt connector with
test leads KDZS 0004 for open
circuit and/or contact
resistance.

Bridge leads at multiple butt
connector.

Set value: approx. 0 Ω

Is set value obtained?



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (12) (CONTINUED)

Test 4: Signal pattern, speed sensor

For testing, use Motortester.

Press special input and %
buttons.

Set lever to left-hand stop
(calibrated voltage range).

Connect Motortester with test
leads KDZS 0004 to connected
multiple butt connector of
speed sensor.

(Plug assignment 1 = +
2 = -)

Run engine at idle speed.

For signal pattern, see
illustration alongside.

Set value: > 2 V

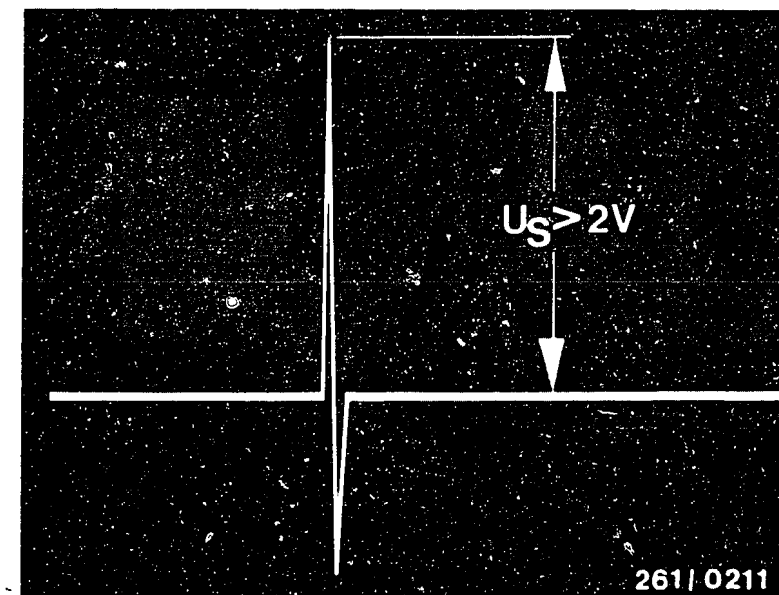
Note:
Positive signal peak must
come first.

Are signal pattern and set
value O.K.?

N>

No signal or signal too small:
speed sensor defective,
replace.

Incorrect signal:
Signal is incorrect if negative
peak comes first.
Test assignment of leads.



Signal pattern

Return to self-diagnosis
test table B21

SELF-DIAGNOSIS TEST PROGRAM (13)

Flashing code: 4.2

Component:
Nozzle-holder assembly with
needle-movement sensor (upper
illustration, arrow)

Test 1: Short circuit to ground

Disconnect cable connector
(1, illustration) from
needle-movement sensor.

Connect ohmmeter with test
leads KDUM 0008 to one
terminal post and ground in
each case.

Set value: > 1 M Ω

Is set value obtained?

N>

Needle-movement sensor defective,
replace nozzle-holder assembly
as a complete unit.

Test 2: Internal resistance

Connect ohmmeter with test
leads KDUM 0008 to both
terminal posts of the multiple
butt connector.

Set value: see brief instruc.

Is set value obtained?

N>

Needle-movement sensor defective,
replace nozzle-holder assembly
as a complete unit.

Continued on next picture page



1 = Multiple butt connector,
needle-movement sen.

SELF-DIAGNOSIS TEST PROGRAM (13) (CONTINUED)

Test 3: Voltage supply

Connect voltmeter with test leads KDZS 0004 to disconnected cable connector (1, lower illustration).

Switch on ignition.

Set value: see brief instruc.

Is set value obtained?

N>

Switch off ignition.

Disconnect control-unit plug 2 (center illustration) and test leads from term. 3 and term. 20 (upper illustration) to multiple butt connector of needle-movement sensor with test leads KDZS 0004 for open circuit and/or contact resistance.

Bridge leads at cable connector (needle-movement sensor).

Set value: approx. 0 Ω

If set value is obtained, replace control unit 2.

Test 4: Voltage signal

Connect multiple butt connector.

Pull back rubber cap on cable connector.

Connect voltmeter with test leads KDZS 0004 to cable connector.

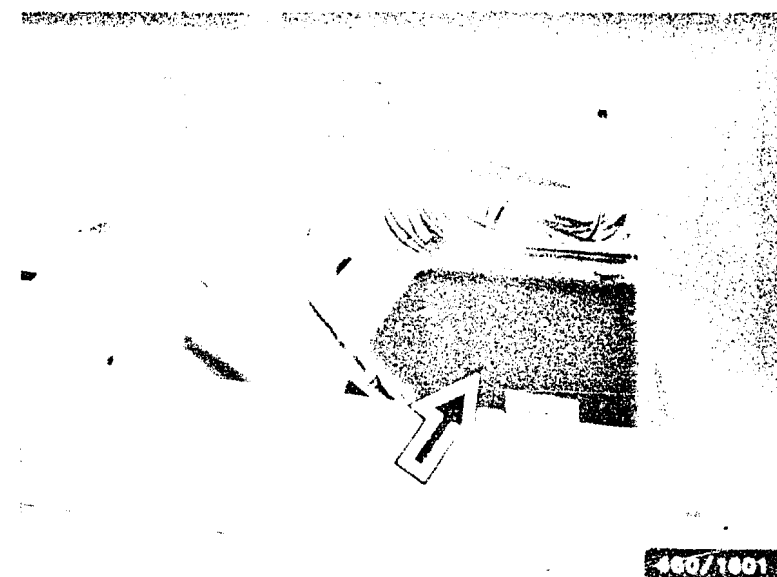
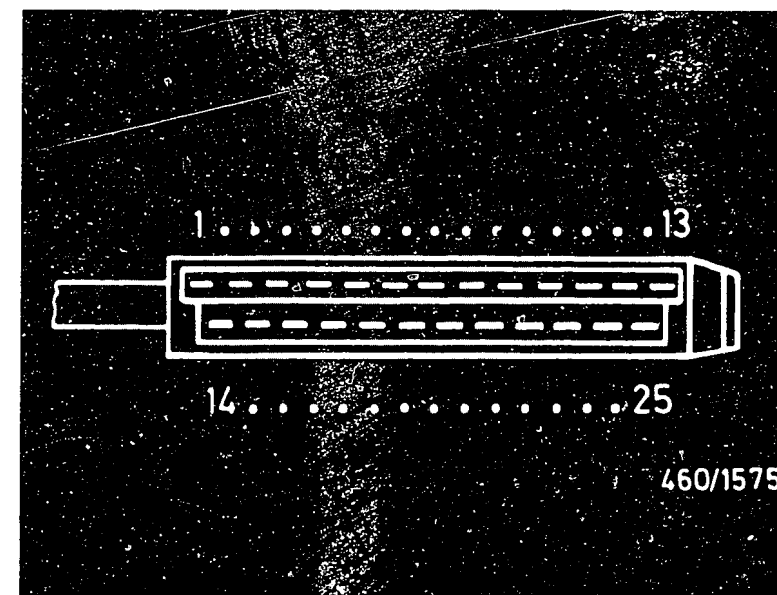
Switch on ignition.

Set value: see brief instruc.

Is set value obtained?

N>

Needle-movement sensor defective, replace nozzle-holder assembly as a complete unit.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (13) (CONTINUED)

Test 5: Signal pattern,
needle-movement sensor

N>

Needle-movement sensor defective,
replace nozzle-holder assembly
as a complete unit.

For testing, use test
oscilloscope or Motortester.

When testing with Motortester,
press buttons for special input,
10 V, 100 ms (or %).

Run engine at idle speed.

Pull back rubber cap on cable
connector.

Connect tester with test leads
KDZS 0004 to connected multiple
butt connector.

For signal pattern, see lower
illustration.

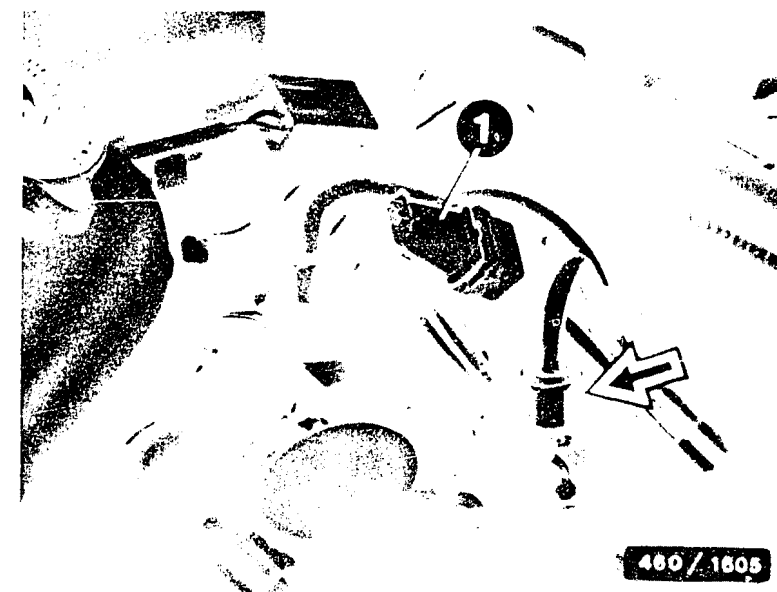
Set value: see brief instruc.

N O T E:

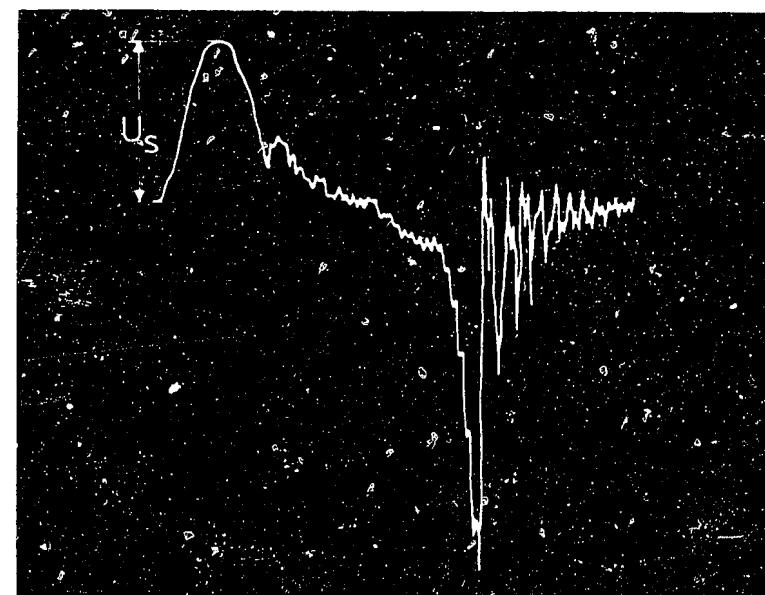
Voltage value (U_s) can
be measured accurately only
with a test oscilloscope.

Is signal pattern present and
is set value obtained?

Return to self-diagnosis
test table B21



1 = Multiple butt connector,
needle-movement sensor



SELF-DIAGNOSIS TEST PROGRAM (14)

Flashing code: 4.3

Component:

Sol.-op. val., start of inj.
(upper illustration, arrow)

Test 1: Short circuit to ground

Disconnect multiple butt
connector (1, lower illustration)
to solenoid-operated valve.

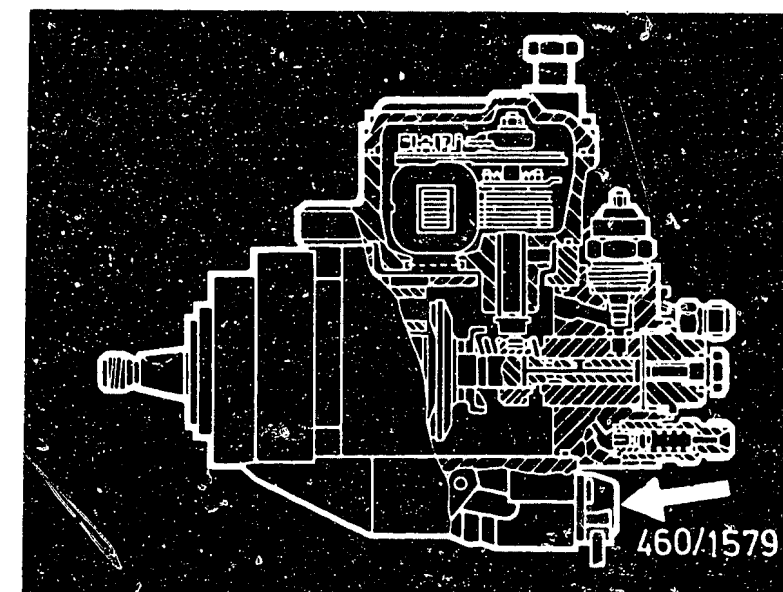
Connect ohmmeter with test
leads KDUM 0008 (2, lower
illustration) to one terminal
post and ground in each case.

Set value: > 1 M Ω

Is set value obtained?

N>

Remove fuel-injection pump.
Replace solenoid-operated valve,
start of injection.



Test 2: Internal resistance

Connect ohmmeter with test
leads KDUM 0008 to both terminal
posts of the multiple butt
connector.

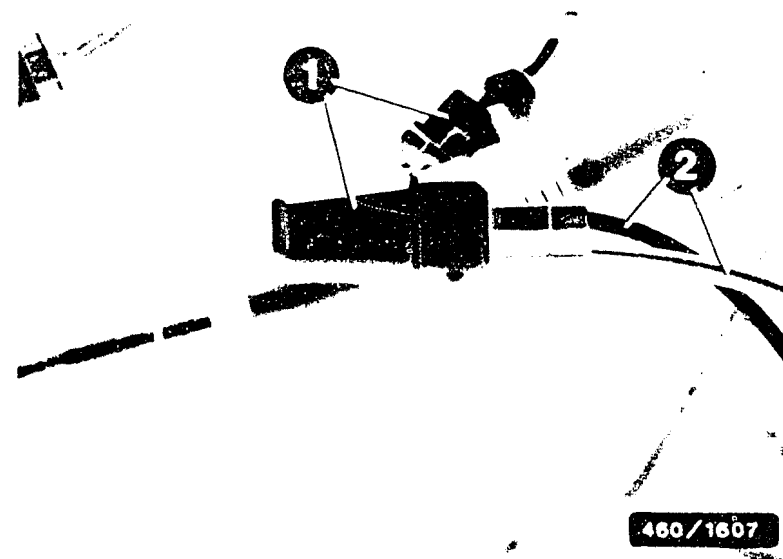
Set value: see brief instruc.

Is set value obtained?

N>

Remove fuel-injection pump.
Replace solenoid-operated valve,
start of injection.

1 = Multiple butt connector to solenoid-operated valve, start of injection
2 = Test lead KDUM 0008



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (14) (CONTINUED)

Test 3: Measuring voltage,
control unit

Connect voltmeter with test
leads KDZS 0004 to disconnected
cable connector.

Switch on ignition.

Set value: approx. 12 V

Is set value obtained?

N>

Switch off ignition.

Disconnect control-unit plug 2
(upper illustration). Test
leads from term. 1 and term. 2
(lower illustration) to
multiple butt connector with
test leads KDZS 0004 for open
circuit and/or contact resistance.

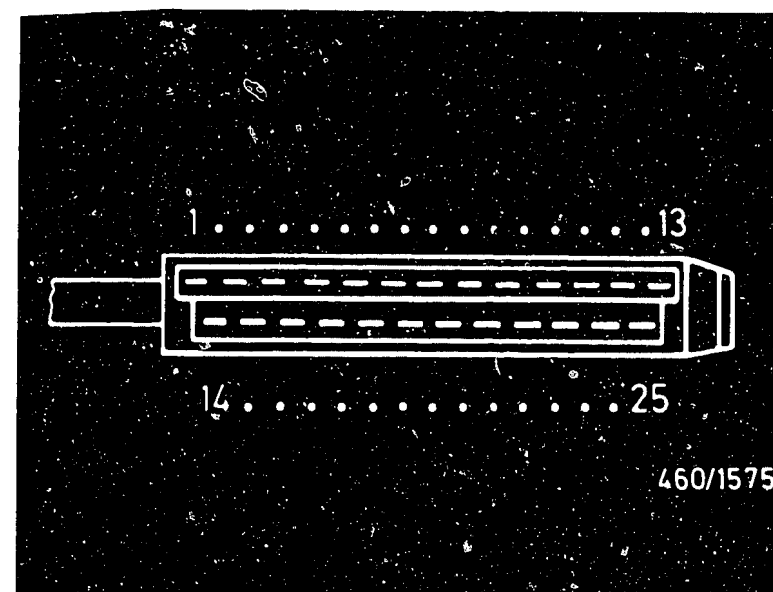
Bridge leads at cable connector
of solenoid-operated valve.

Set value: approx. 0 Ω

If set value is obtained,
replace control unit 2.

Arrow = Start-of-injection and
exhaust-gas-recirculation co
unit

(Designated control unit 2
in these trouble-shooting
instructions)
Installation position:
Behind the glove compartment



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (14) (CONTINUED)

Test 4: Actuation on/off ratio

N>

Pull back rubber cap on cable connector (upper illustration).

Connect pocket tester with test leads KDZS 0004 (2) to connected multiple butt connector (1).

Set measuring range for dwell angle. Run engine at idle speed.

Coolant temperature approx. + 80° C.

Disconnect cable connector from needle-movement sensor.

Set value: see brief instruc.

Connect cable connector of needle-movement sensor.

Set value: see brief instruc.

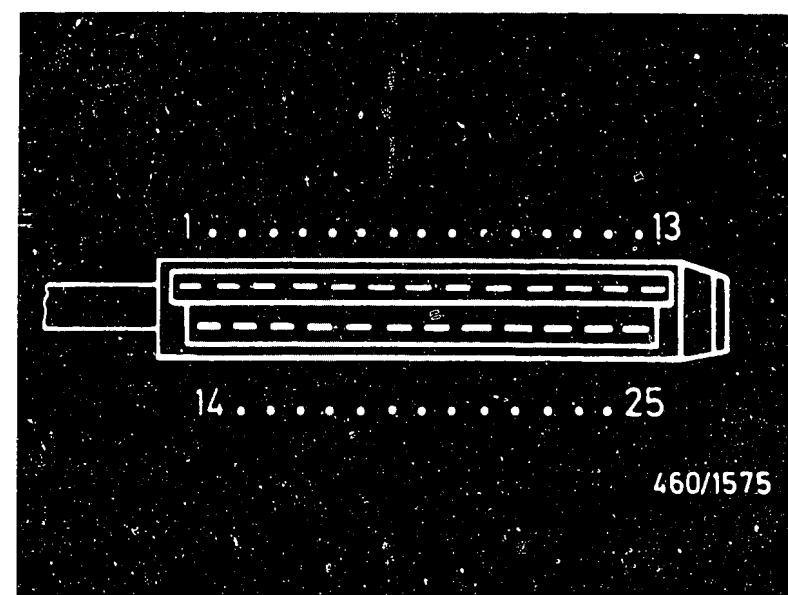
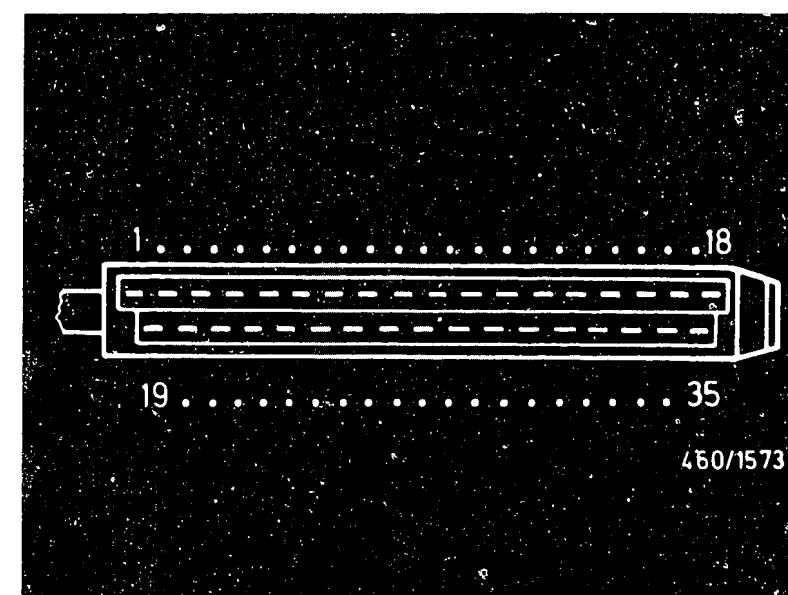
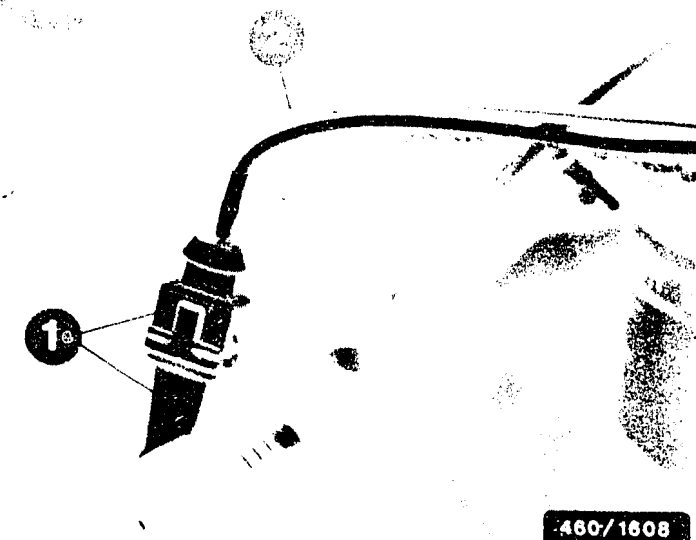
Does the on/off ratio change when needle-movement-sensor plug is disconnected or engine speed increased?

Disconnect control-unit plugs 1 and 2 (center and lower illustrations).

Test lead term. 8 (control-unit plug 1) to lead term. 6 (control-unit plug 2) for open circuit.

Eliminate open circuit.

If there is no open circuit, replace control unit 2.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (14) (CONTINUED)

V

Test 5: Function,
solenoid-operated valve,
start of injection

N>

Coolant temperature < 30° C.

Run engine at idle speed.

Disconnect cable connector
from needle-movement sensor.

Disconnect multiple butt conn.
from solenoid-operated valve.

Is the engine heard to run
harsher if injection is
advanced?

Remove fuel-injection pump.

Cause of trouble e.g. solenoid-
operated valve or timing device
jammed.

Y

Return to self-diagnosis
test table B23

V

E07

<=>

E08

<=>

SELF-DIAGNOSIS TEST PROGRAM (15)

Flashing code : 5.1

Component:
Control-unit computer interface
(stored fault)

Test 1:
Data lines of the control units
Test instruction:
Fault is not present at
time of test; therefore, pay
particular attention to:
* Loose contacts at plug
connections.
* Fouled, corroded and pushed-
back plug-in contacts.
* Breaks in leads in form of
kinked or pinched locations.
Switch off ignition.
Disconnect control-unit plugs 1
(center illustration) and 2
(lower illustration).
Connect ohmmeter with test
leads KDZS 0004 to terminals
listed below (upper illus-
tration).

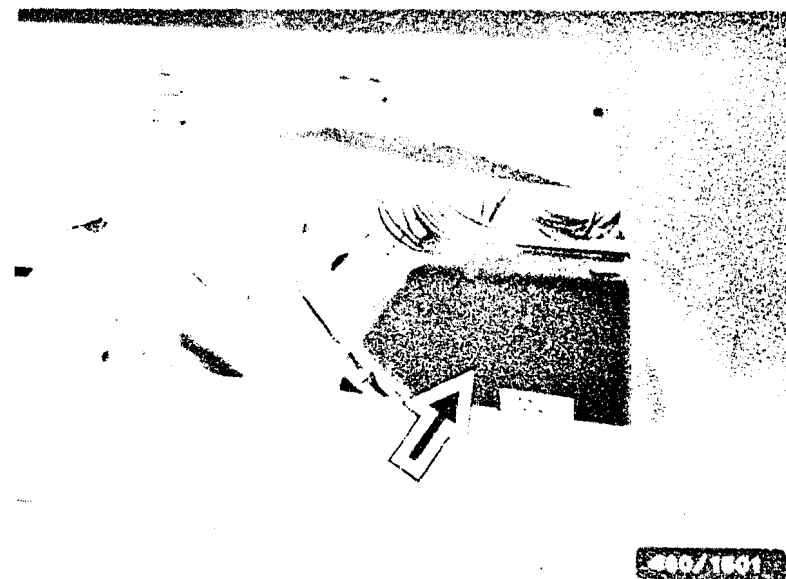
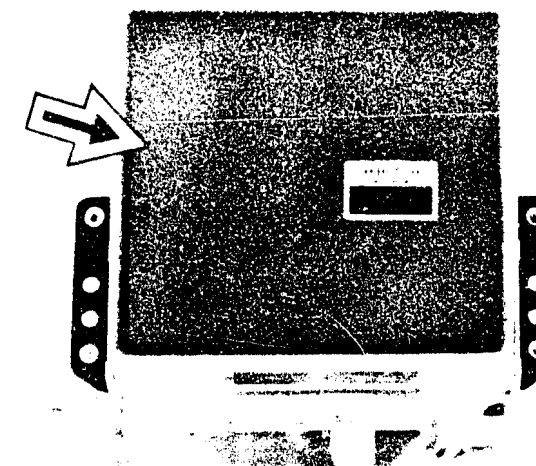
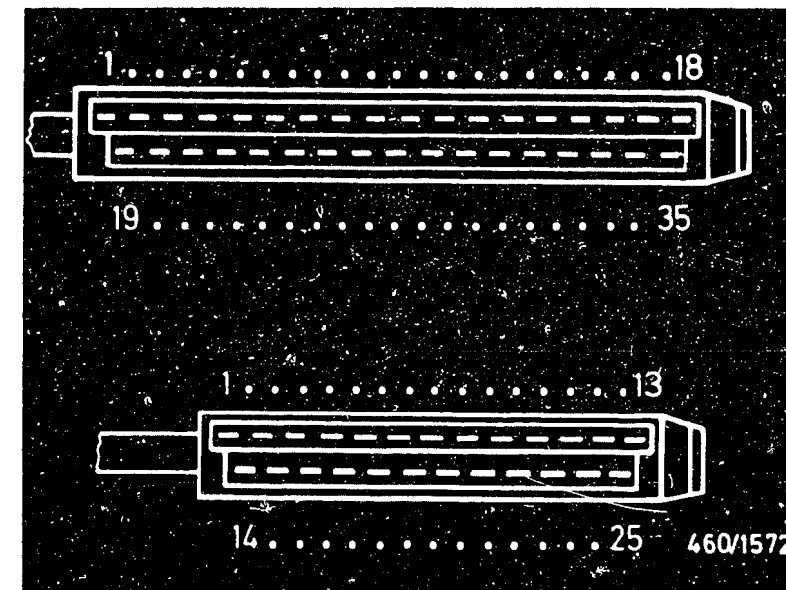
Control-unit plug 1	Control-unit plug 2
Term. 14 and	Term. 9
Term. 15 and	Term. 12

Move the connecting leads of
the control units while testing.
Set value: approx. 0 Ω
Is set value obtained?

N>

Test appropriate lead path for
open circuit and/or contact
resistance.

Eliminate open circuit and/or
contact resistance.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (15) (CONTINUED)

Test 2: Control units

Connect cable connector to control units.

Switch on ignition.

Start engine and run at idle speed.

Activate self-diagnosis.

If flashing code 5.2 is not indicated, computer interface is O.K.

Switch off engine.

N>

Determine defective control unit by exchanging.

Return to self-diagnosis test table B23

SELF-DIAGNOSIS TEST PROGRAM (16)

Flashing code: 5.2

Component:
Control-unit computer interface
(present fault)

Test 1:

Data lines of the control
units

NOTE:

Fault is present at
time of test.

Switch off ignition.

Disconnect control-unit plugs 1
(center illustration) and 2
(lower illustration).

Connect ohmmeter with test
leads KDZS 0004 to terminals
listed below (upper illus-
tration).

Control-unit plug 1	/	Control-unit plug 2
Term. 14	and	Term. 9
Term. 15	and	Term. 12

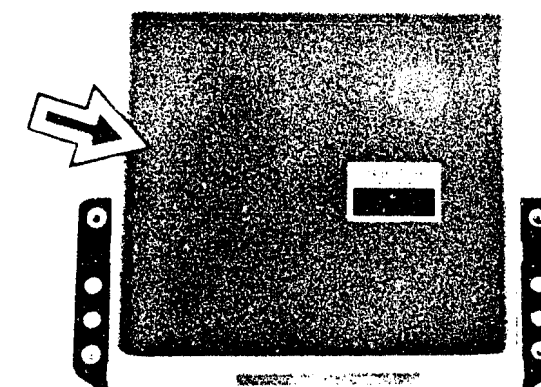
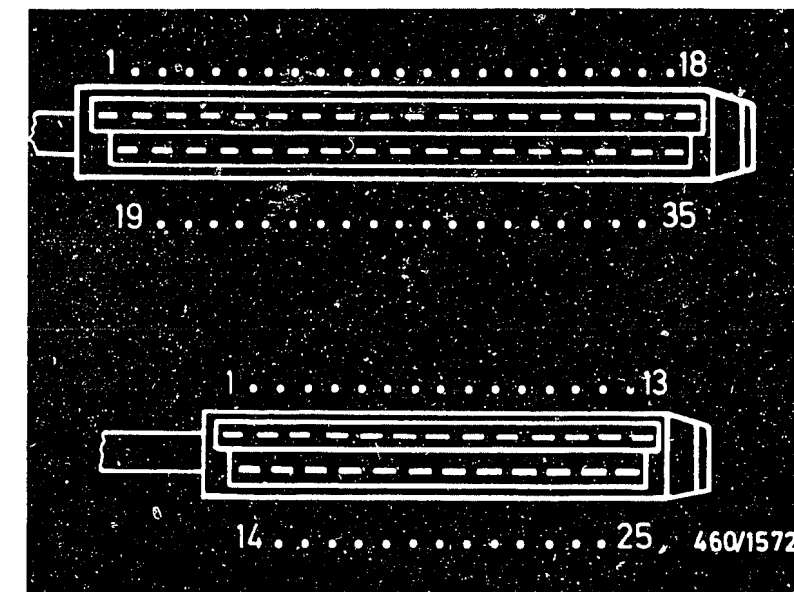
Set value: approx. 0 Ω

Is set value obtained?

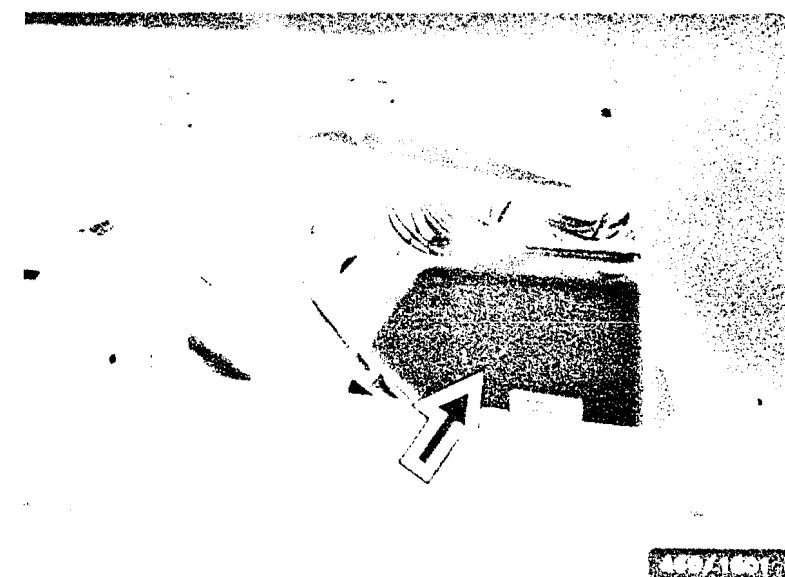
N>

Test appropriate lead path for
open circuit and/or contact
resistance.

Eliminate open circuit and/or
contact resistance.



460/1574



460/1574

Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (16) (CONTINUED)

V

Test 2: Control units

Connect cable connector to control units.

Switch on ignition.

Start engine and run at idle speed.

Activate self-diagnosis.

If flashing code 5.2 is not indicated, computer interface is O.K.

Switch off engine.

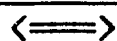
N>

Determine defective control unit by exchanging.

V

Return to self-diagnosis test table B25

E15



E16



SELF-DIAGNOSIS TEST PROGRAM (17)

V

Flashing code: 5.2

Component:

Computer monitoring
Control unit 1

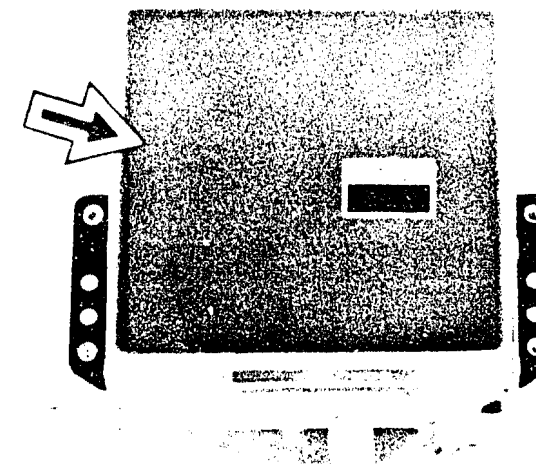
N>

Control unit 1 defective,
replace.

Can the engine be started and
run at any speed when flashing
code 5.2 is indicated?

Y

Return to self-diagnosis
test table B25



460/1574

Arrow = Delivery and road-
speed control unit
(Designated control unit 1
in these trouble-shooting
instructions)
Installation position:
Behind footrest on
passenger's side

E17

<==>

E18

<==>

SELF-DIAGNOSIS TEST PROGRAM (18)

V

Flashing code: Steady light

Component:
Computer monitoring
Control unit 2

Test requirement:

Indicator lamp of self-diagnosis
lights with steady light and
no flashing code is indic-
ated when the test switch is
actuated.

Exhaust-gas recirculation
switched off.

Test: Measuring voltage,
control unit 2

Disconnect multiple butt
connector (1) from solenoid-
operated valve of start of inj..

Connect voltmeter with test
leads KDZS 0004 to disconnected
cable connector.

Switch on ignition.

Set value: approx. 12 V

Is set value obtained?

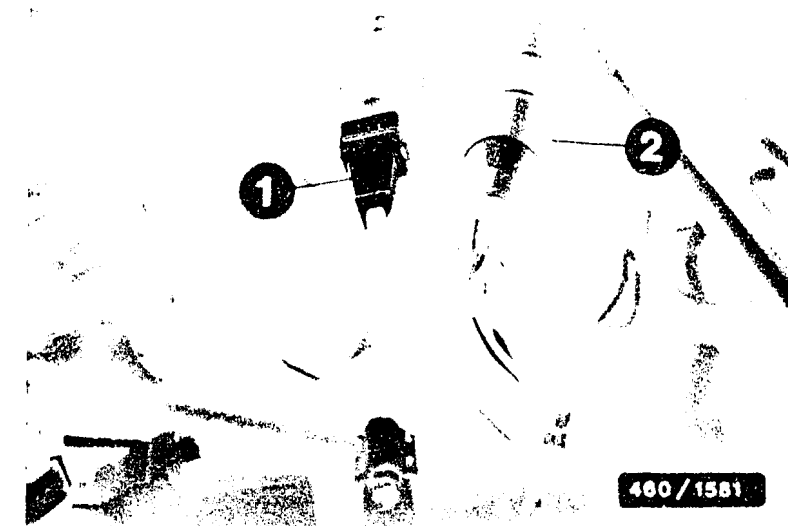
Y

V

Return to self-diagnosis
test table B25

Control unit 2 defective,
replace.

N>



Arrow = Start-of-injection and
exhaust-gas-recirculation co
unit

(Designated control unit 2
in these trouble-shooting
instructions)

Installation position:
Behind the glove compartment



TROUBLE-SHOOTING PROGRAM (1)

V

Component/function:

Voltage supply,
control units

N>

Test 1: Rev.-pol. protection rel.
(upper ill., arrow)

Connect voltmeter with commercially available test leads and test prods to output of reversed-polarity protection relay (term. 87).

Switch on ignition.

Set value: 11.5...14.5 V

Is set value obtained?

Y

V

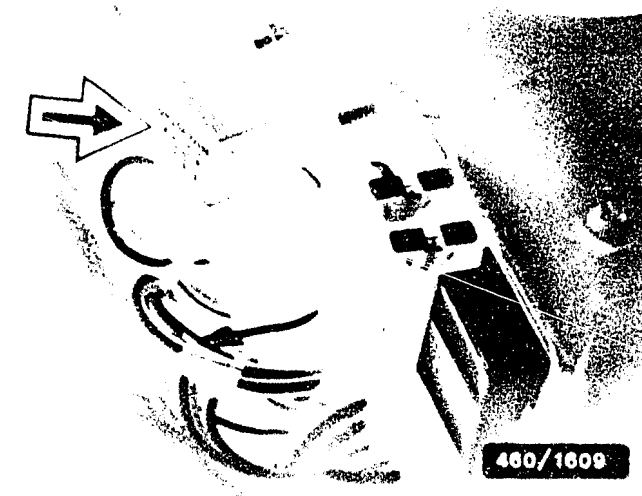
Continued on next picture page

Test functioning and activation
of reversed-polarity pro. rel.

+ 15 at term. 87
+ 30 at term. 30
- 31 at term. 85
+ 30 at term. 87

Eliminate any open circuit
present in leads.

If there is no voltage when
term. 87 is activated correctly,
replace reversed-polarity protection relay.



V

Test 2:
Voltage supply, control units

N>

Switch off ignition.

Disconnect control-unit plugs
1 and 2.

Connect voltmeter with test
leads KDZS 0004 to terminals
listed below.

Control-unit plug 1

Term. 2 (+) and 19 (-)

Term. 3 (+) and 20 (-)

Control-unit plug 2

Term. 5 (+) and 14 (-)

Term. 19 (+) and 15 (-)

Switch on ignition.

Set value: 11.5...14.5 V

Is set value obtained?

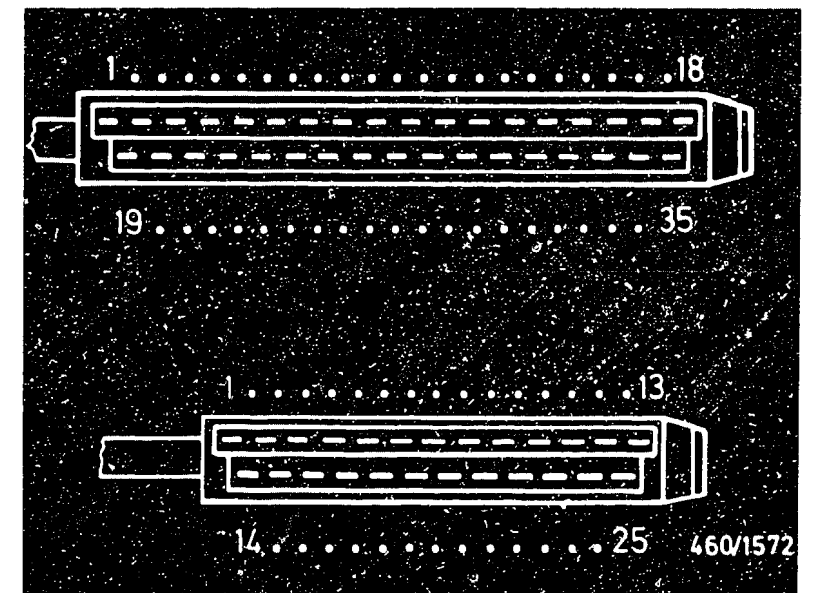
Y

V

Return to trouble-shooting chart
B04

Test appropriate lead path for
open circuit.

Eliminate open circuit.



TROUBLE-SHOOTING PROGRAM (2)

Component/function:

Gear-shift valve, road-speed control (see illustration, arrow)

Test 1: Internal resistance

Disconnect cable connector from shift valve.

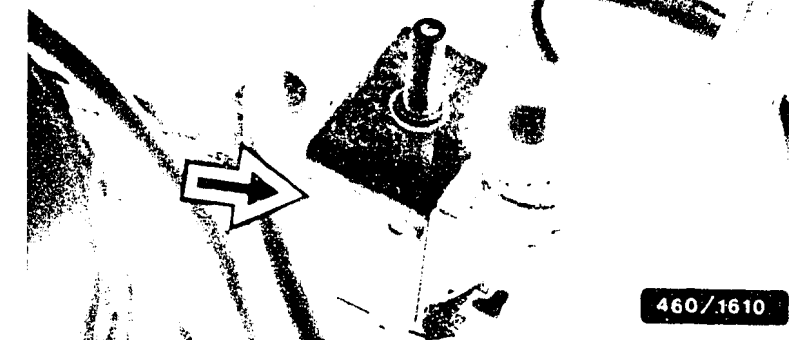
Connect ohmmeter with test leads KDUM 0007 to shift valve.

Set value: see brief instruc.

Is set value obtained?

N>

Shift valve defective, replace.



Test 2: Measuring voltage, control unit

Connect voltmeter with test leads KDZS 0005 to cable connector (shift valve).

Switch on ignition.

Set value: approx. 12.0 V

Is set value obtained?

N>

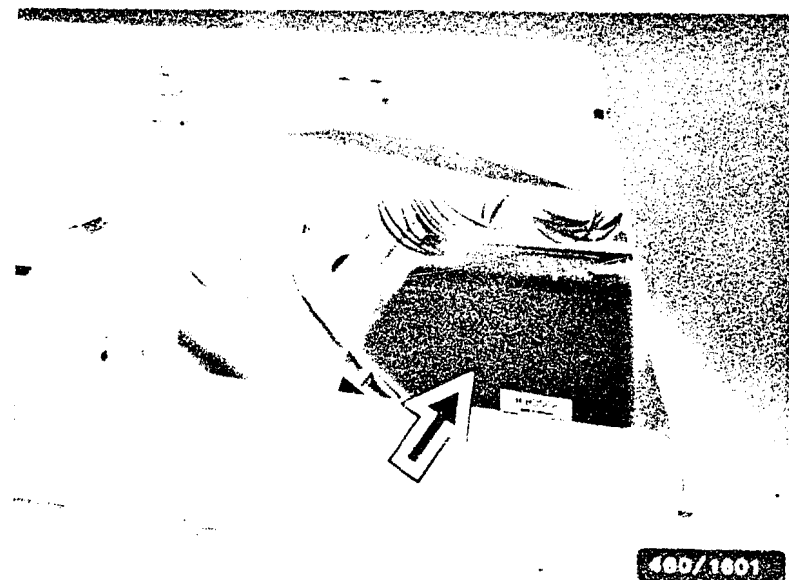
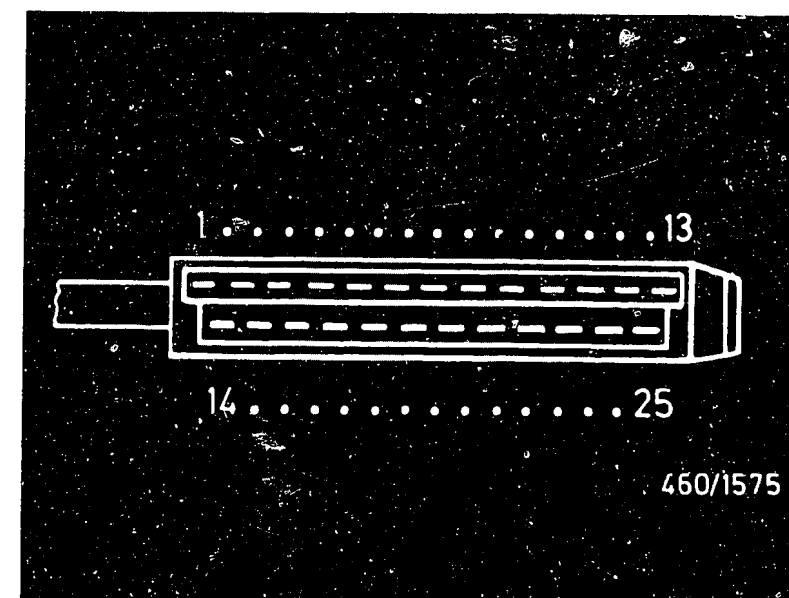
Switch off ignition.

Disconnect control-unit plug 2 and test leads term. 1 and term. 11 (center illustration) to cable connector of shift valve for open circuit.

Bridge leads at cable connector (shift valve).

Set value: approx. 0 Ω

If set value is obtained, replace control unit 2 (lower illustration, arrow).



Continued on next picture page

TROUBLE-SHOOTING PROGRAM (2) CONTINUED (1)

V

Test 3: Vacuum control,
transmission-shift
valve
(Illustration, arrow)

N>

Switch off ignition.

Connect control-unit plug and
cable connector to component.

Drive vehicle on chassis
dynamometer at speed exceeding
40 km/h.

Switch on road-speed control.

Is vacuum passed on from gear-
shift valve to pressure
transducer of speed control?

V

Return to trouble-shooting chart
B04

Test vacuum hoses for
leaks.

If there are no leaks, replace
gear-shift valve.



TROUBLE-SHOOTING PROGRAM (3)

Component/function:
Operating switch, road-speed
control "ON"

N>

Test 1: Pressure switch,
road-speed control "ON"
(upper illustration, arrow)

Connect voltmeter with commercially
available test leads and test
prods to output of pressure
switch.

Switch on ignition and actuate
switch.

Set value: 11.5...14.5 V

Is set value obtained?

Test instrument lead for open
circuit.
Eliminate open circuit.

If set value is obtained at the
pressure-switch input, replace
pressure switch.

Test 2: Rocker switch,
"setting" road-speed control
(center illustration)

N>

Disconnect control-unit plug 1.

Connect voltmeter with test
leads KDZS 0004 to control-unit
plug 1 term. 18 (+) and 19 (-)
(lower illustration).

Switch on ignition.
Actuate rocker switch in
direction "setting" road-speed
control

Set value: 11.5...14.5 V

Is set value obtained?

Test lead from pressure switch,
road-speed control "ON" to
rocker switch "setting road-
speed control" for open circuit.

Eliminate open circuit.

Test rocker switch for open
circuit and replace if nec-
essary.

Test lead term. 18 from cable
connector of pressure switch to
rocker switch, "setting road-
speed control" for open circuit.

Eliminate open circuit.

Continued on next picture page

CRUISE
CONTROL

460/1611

460/1612

460/1573

TROUBLE-SHOOTING PROGRAM (3) CONTINUED (1)

Test 3: Speed control

Switch off ignition.

Connect control-unit plug 1.

Drive vehicle on chassis dynamometer or road at speed exceeding 40 km/h.

Switch on road-speed control at pressure switch.

Actuate rocker switch "setting road-speed control".

Is set road speed maintained?

Control unit 1 defective, replace.

Return to trouble-shooting chart B04



Arrow = Delivery and road-speed control unit
(Designated control unit 1 in these trouble-shooting instructions)
Installation position:
Behind footrest on passenger's side

TROUBLE-SHOOTING PROGRAM (4)

Component/function:
Switches,
Brake pedal/clutch pedal

Test 1: Switch, brake pedal

Does stop lamp light when
brake pedal is actuated?

N>

Test voltage supply at
switch.

If voltage is present at
switch, replace brake pedal.

Test 2: Brake signal at
control unit

Switch off ignition.

Disconnect control-unit plug 1.

Connect voltmeter with test
leads KDZS 0004 to control-unit
plug 1 term. 19 (-) and term. 11
(+) and to term. 27 (+) (upper
illustration).

Switch on ignition and
actuate brake pedal.

Set value: 11.5...14.5 V

Is set value obtained?

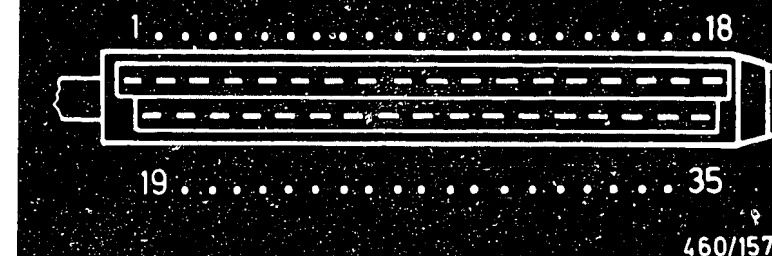
N>

No voltage at term. 11;
test lead for open circuit.
Eliminate open circuit.

No voltage at term. 27; test
lead for open circuit and
clutch switch for proper
operation.

N o t e:

No voltage present at term. 27
if clutch pedal and brake
pedal are actuated simul-
taneously.



Continued on next picture page

TROUBLE-SHOOTING PROGRAM (4) CONTINUED (1)

Test 3: Cutoff of speed
control

Switch off ignition.

Connect control-unit plug 1.

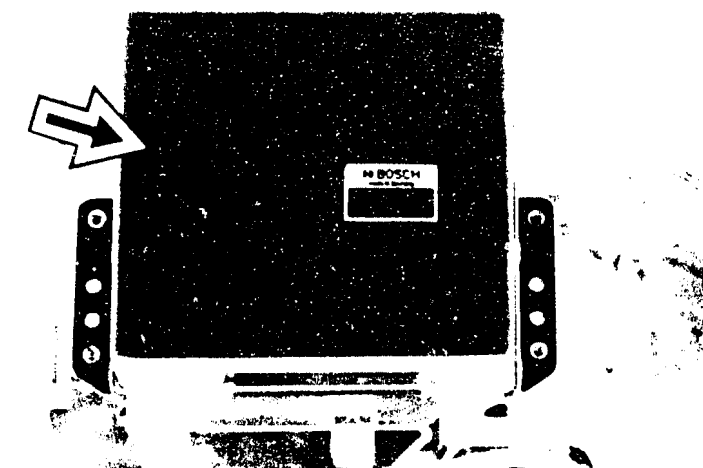
Drive vehicle on chassis
dynamometer or road at speed
exceeding 40 km/h.

Switch on road-speed control
at pressure switch.

Is set road speed interrupted
when brake pedal is actuated?

Control unit 1 defective,
replace.

Return to trouble-shooting chart
B04



460/1574

Arrow = Delivery and road-
speed control unit
(Designated control unit 1
in these trouble-shooting
instructions)
Installation position:
Behind footrest on
passenger's side

TROUBLE-SHOOTING PROGRAM (5)

Component/function

Rocker switch, "road-sp. ctrl OFF"

N>

Test 1: Rocker switch
"road-speed control OFF"
(upper illustration, arrow)

Disconnect control-unit plug 1.

Connect voltmeter with test leads
KDZS 0004 to control-unit plug 1
term. 5 (+) and term. 19 (-)
(lower illustration).

Switch on ignition.

Set value: 11.5...14.5 V

Actuate rocker switch of road-
speed control in direction "OFF".

Set value: 0 V

Is set value obtained?

Y

V

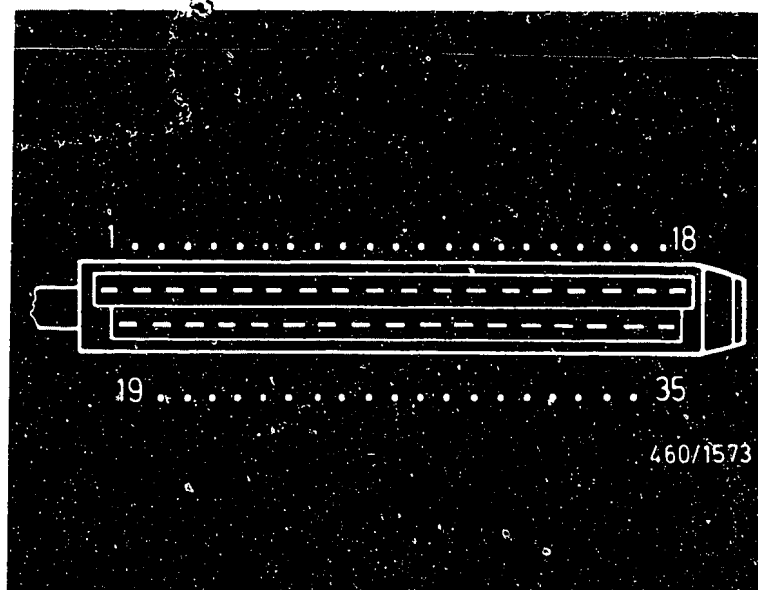
Continued on next picture page

Test rocker switch of road-speed
control for proper operation
and replace if necessary.

Test lead term. 5 from control-
unit plug 1 to road-speed
control rocker switch for open
circuit.
Eliminate open circuit.



460/1612



460/1573

TROUBLE-SHOOTING PROGRAM (5) CONTINUED (1)

Test 2: Speed control

Switch off ignition.

Connect control-unit plug 1.

Drive vehicle on chassis dynamometer or road at speed exceeding 40 km/h.

Switch on road-speed control at pressure switch.

Set road speed at rocker switch and interrupt again via "OFF".

Is road-speed control switched off?

Control unit 1 defective, replace.

Return to trouble-shooting chart B04



Arrow = Delivery and road-speed control unit
(Designated control unit 1 in these trouble-shooting instructions)
Installation position:
Behind footrest on passenger's side

TROUBLE-SHOOTING PROGRAM (6)

V

Component/function:

Operating switch, road-speed control "reinstatement"

N>

Test 1: Rocker switch, road-speed control "reinstatement" (see illustration - arrow)

Disconnect control-unit plug 1.

Connect voltmeter with test leads KDZS 0004 to control-unit plug 1 term. 19 (-) and term. 30 (+) (lower illustration).

Switch on ignition.

Actuate rocker switch of road-sp. ctrl. in direction "reinstatement".

Set value: 11.5...14.5 V

Is set value obtained?

Y

V

Continued on next picture page

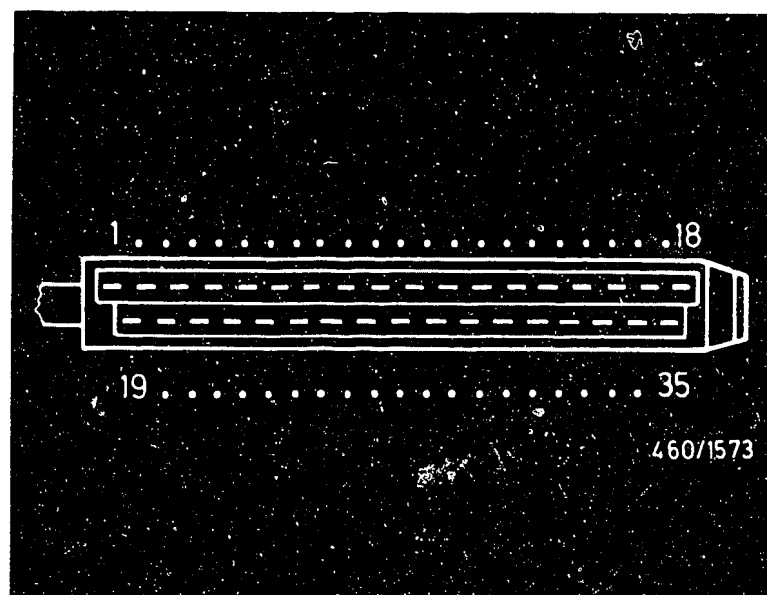
Test rocker switch of road-speed control for open circuit and replace switch if necessary.

Test lead term. 30 from control-unit plug 1 to road-speed-control rocker switch for open circuit.

Eliminate open circuit.



460/1612



460/1573

1 TROUBLE-SHOOTING PROGRAM (6) CONTINUED (1) 1

Test 2: Speed control

Switch off ignition.

Connect control-unit plug 1.

Drive vehicle on chassis dynamometer or road at speed exceeding 40 km/h.

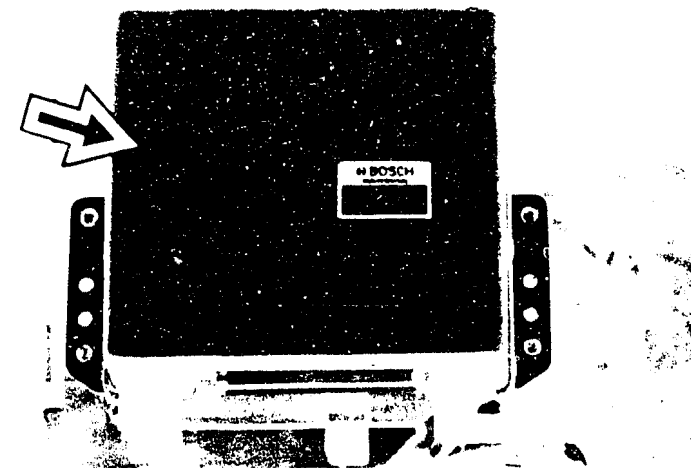
Switch on road-speed control at pressure switch.

Set road speed at rocker switch and interrupt again via road-speed control "OFF".

Actuate rocker switch "rein-statement."

Is the previously stored speed reinstated?

N> Control unit 1 defective, replace.



Arrow = Delivery and road-speed control unit
(Designated control unit 1 in these trouble-shooting instructions)
Installation position:
Behind footrest on passenger's side

Y
Return to trouble-shooting chart B04

TROUBLE-SHOOTING PROGRAM (7)

Component/function
Exhaust-gas recirculation

N>

Exhaust-gas-recirculation valve
defective, replace.

Test 1: Exhaust-gas-recir-
culation valve (2)

Prerequisite:

- Engine at normal operating temperature, approx. +80°C
- Actuation on/off ratio of pressure transducer (1) avail.
- Vacuum at pressure-transducer outlet

Run engine at approx. 1000 min⁻¹.

Does the exh.-gas-recir.val. open?



Test 2: Throttle valve,
intake air (3)

N>

Throttle valve defective,
replace.

Switch off engine and connect
vacuum pump to pressure hose (4).

Generate vacuum with the aid of
the pump (throttle valve closes).

Disconnect pressure hose.

Is throttle valve heard to
close?



Return to trouble-shooting chart
B04

TESTING THE PREHEATING SYSTEM

Necessary test equipment

Preheating tester e.g. ETT 011.00
Part no. 0 684 101 100

Workshop instructions

We recommend that the R-type sheathed-
element glow plug be replaced every
45 000 km.

Note:

If the start of delivery is set incorrectly,
this may lead to the service life of the
sheathed-element glow plug being considerably
reduced.

Preheating times

The operating time of the preheating system
is dependent upon the ambient temperature.

For production reasons:
continued on the following
coordinate.

TESTIN PREHEATING SYSTEM 1

Test the voltage supply of the R-type sheath-element glow plugs

N>

Connect voltmeter at R-type sheath-element glow plug to ground. Position glow-plug and starter switch to position ON and then position to Start position.

A minimum voltage of 10 V must be indicated for at least 11 seconds (temperature-dependent).

When this time has elapsed, the system switches off automatically.

Minimum voltage present?

Test starting repeater lamp

N>

Position glow-plug and starter switch to position ON and then position to Start position.

Starting repeater lamp must light up.

Does starting repeater lamp light up?

1. Voltage below 10 V, then test power circuit (battery +) as well as term. 1 and term. 5 of the glow-duration control unit for voltage drop. Eliminate voltage drop.

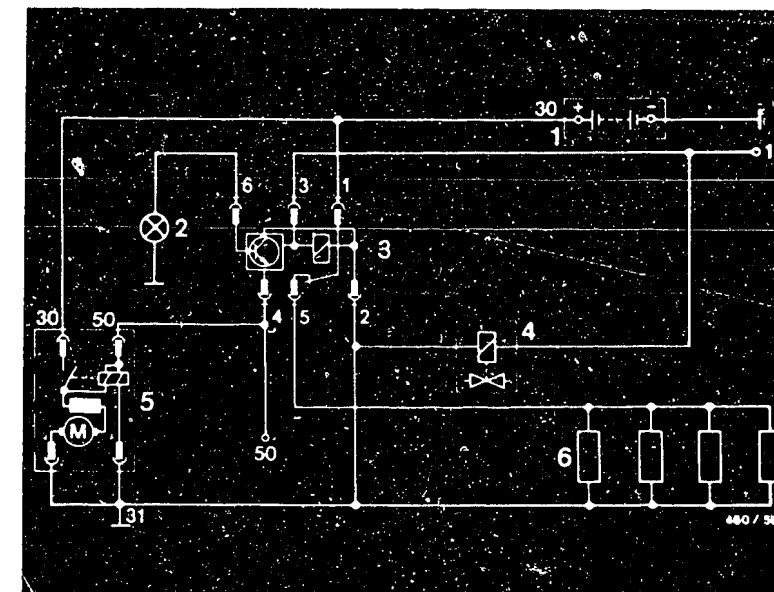
2. If no voltage available, check lead from R-type sheathed-element glow plug to glow-duration control unit term. 5 for open circuit. Eliminate open circuit. If no open circuit, continue on Coordinate F27.

Continuation here not necessary.

1. Test lead from glow-plug and starter switch term.15 to glow duration control unit term. 3 for open circuit. Eliminate open circuit.

2. Test lead from glow-duration control unit term. 6, including starting repeater lamp and its ground, for open circuit. Eliminate open circuit.

3. Test ground cable term. 2 of glow-duration control unit for open circuit. Eliminate open circuit.



- 1 = Battery
- 2 = Preheating repeater lamp (12 V, 2 W)
- 3 = Glow-duration control unit
- 4 = Solenoid-operated valve
- 5 = Starting motor
- 6 = Sheathed-element glow plugs

Continued on next picture page

TESTIN PREHEATING SYSTEM 2

Test preheating duration

Position glow-plug and starter switch to position ON and then position to Start position. Preheating duration (starting repeater lamp lights) must be as follows at the ambient temperatures given:

0° C - 7...11 seconds
 + 10° C - 6...10 seconds
 + 20° C - 4... 8 seconds
 + 30° C - 3... 6 seconds
 + 40° C - 1... 5 seconds.

Preheating duration (seconds)
 O.K.?

N>

Replace glow-duration control unit.

Y
V

Test safety circuit

Connect voltmeter at R-type sheathed-element glow plug to ground. Position glow-plug and starter switch to position ON and then position to Start position. Voltmeter must indicate a voltage at an ambient temperature of:

0° C for 16...20 seconds
 + 10° C for 15...19 seconds
 + 20° C for 14...18 seconds
 + 30° C for 13...17 seconds
 + 40° C for 12...16 seconds.

When the specified time has elapsed, the voltmeter must indicate 0 V.

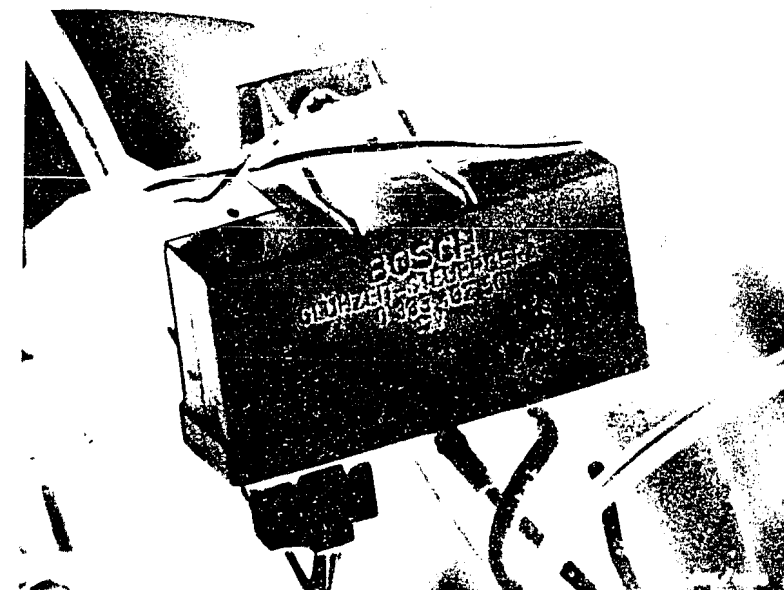
Does voltmeter indicate
 0V after specified time?

N>

Replace glow-duration control unit.

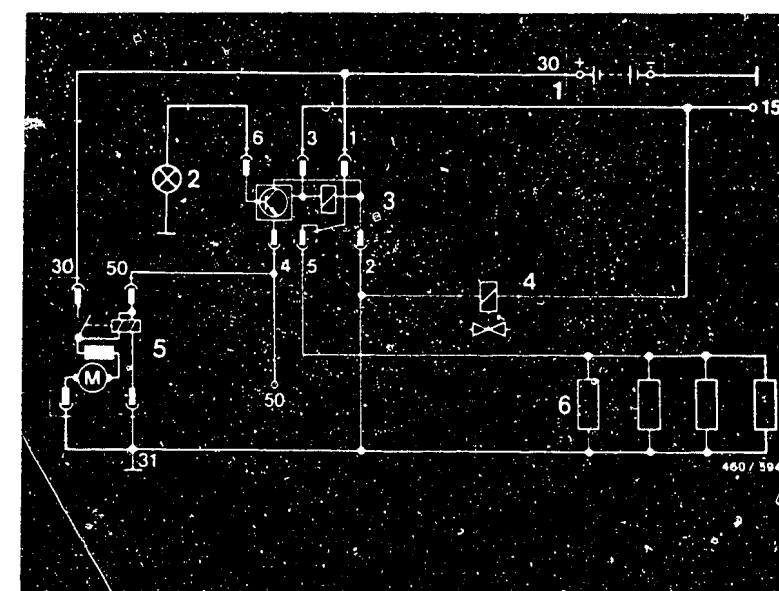
Y
V

Continued on next picture page



Installation position,
 glow-duration control unit

- 1 = Battery
- 2 = Preheating repeater lamp (12 V, 2 W)
- 3 = Glow-duration control unit
- 4 = Solenoid-operated valve
- 5 = Starting motor
- 6 = Sheathed-element glow plugs



TEST IN PREHEATING SYSTEM 3

Check that glow plugs glow when starting motor is activated

Connect voltmeter at R-type sheathed-element glow plug to ground.
Position glow-plug and starter switch to Start position.

Voltmeter must indicate 6...10 V.

Voltage present?

N>

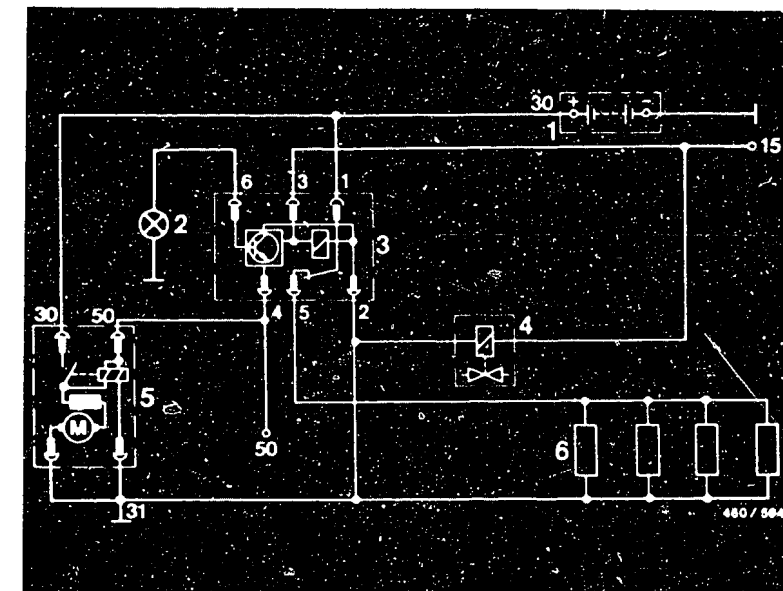
1. Test lead from glow-plug and starter switch term. 50 to glow-duration control unit term. 4 for open circuit. Eliminate open circuit.
2. If point 1 is O.K., replace glow-duration control unit.

Test R-type sheathed-element glow plug
Test R-type sheathed-element glow plugs separately for continuity using ohmmeter.

Does R-type sheathed-element glow plug have continuity?

N>

Replace R-type sheath.-elem. glow plug



- 1 = Battery
- 2 = Preheating repeater lamp (12 V, 2 W)
- 3 = Glow-duration control unit
- 4 = Solenoid-operated valve
- 5 = Starting motor
- 6 = Sheathed-element glow plugs

Preheating system O.K.?

Testing as of F27 not necessary.

TEST IN PREHEATING SYSTEM 4

Test voltage at glow-duration control unit term. 3

Connect voltmeter at glow-duration control unit term. 3 to ground.
Position glow-plug and starter switch to position ON and then position to Start position.
Voltmeter must indicate battery voltage.
Battery voltage present?

N>

Test lead from glow-duration control unit term. 3 to glow-plug and starter switch for open circuit.

Eliminate open circuit.

Test ground cable term. 2 of glow-duration control unit.

Connect voltmeter to glow-duration control unit term. 2 and battery +.
Voltmeter must indicate battery voltage.
Battery voltage present?

N>

Test ground cable term. 2 of glow-duration control unit for open circuit.

Eliminate open circuit.

Test voltage at glow-duration control unit term. 1

Connect voltmeter at glow-duration control unit term. 1 to ground.
Voltmeter must indicate battery voltage.
Battery voltage present?

N>

Test lead from glow-duration control unit term. 1 to battery + for open circuit.

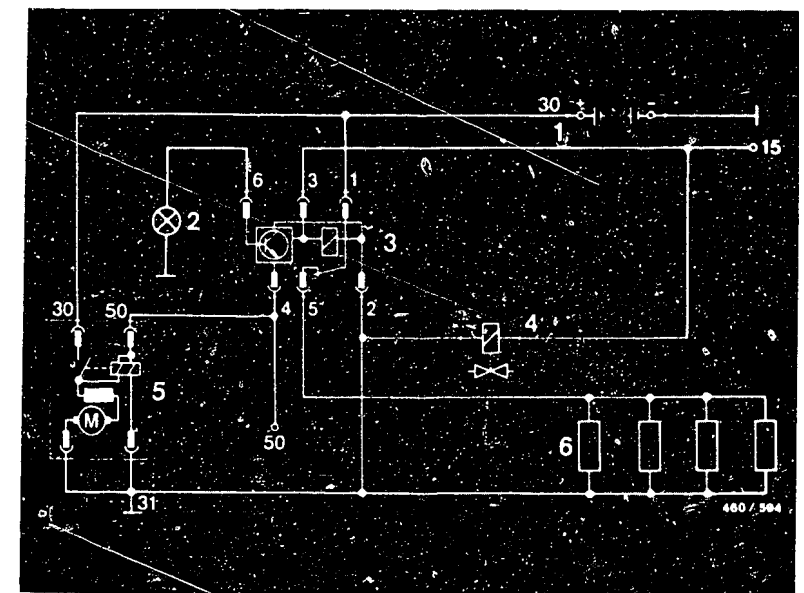
Eliminate open circuit.

Voltage at R-type sheathed glow plug now present?

N>

Replace glow-duration control unit.

Continued on next picture page



- 1 = Battery
- 2 = Preheating repeater lamp (12 V, 2 W)
- 3 = Glow-duration control unit
- 4 = Solenoid-operated valve
- 5 = Starting motor
- 6 = Sheathed-element glow plugs

TEST IN PREHEATING SYSTEM 5

Test starting repeater lamp

Position glow-plug and starter switch to position ON and then position to Start position.

Starting repeater lamp must light up.

Does starting repeater lamp light up?

N>

1. Test lead from glow-plug and starter switch term. 15 to glow duration control unit term. 3 for open circuit. Eliminate open circuit.

2. Test lead from glow-duration control unit term. 6, including starting repeater lamp and its ground, for open circuit. Eliminate open circuit.

3. Test ground cable term. 2 of glow-duration control unit for open circuit. Eliminate open circuit.

Replace glow-duration control unit.

Test preheating duration

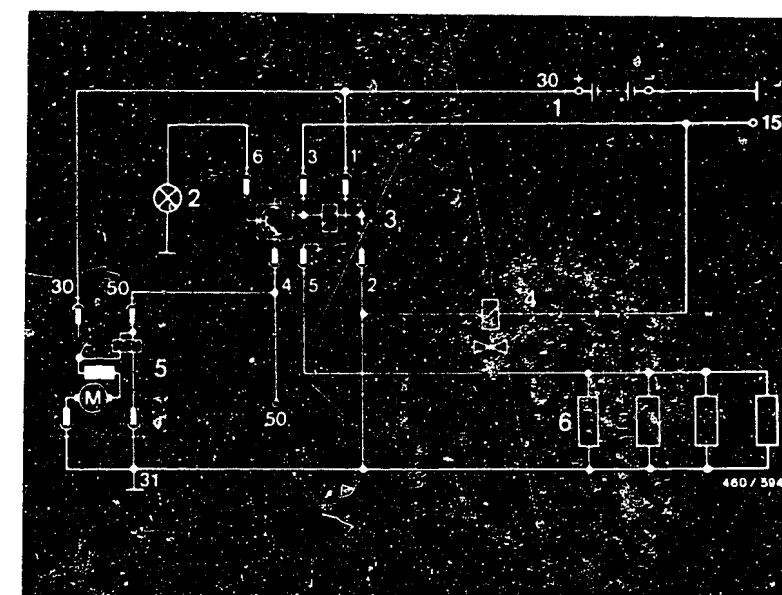
Position glow-plug and starter switch to position ON and then position to Start position. Preheating duration (starting repeater lamp lights) must be as follows at the ambient temperatures given:

0° C - 7...11 seconds
+ 10° C - 6...10 seconds
+ 20° C - 4... 8 seconds
+ 30° C - 3... 6 seconds
+ 40° C - 1... 5 seconds.

Preheating duration (seconds)
O.K.?

N>

Continued on next picture page



- 1 = Battery
- 2 = Preheating repeater lamp (12 V, 2 W)
- 3 = Glow-duration control unit
- 4 = Solenoid-operated valve
- 5 = Starting motor
- 6 = Sheathed-element glow plugs

TESTIN PREHEATING SYSTEM 6

Test safety circuit
Connect voltmeter at R-type sheathed-element glow plug to ground. Position glow-plug and starter switch to position ON and then position to Start position. Voltmeter must indicate a voltage at an ambient temperature of:

- 0° C for 16...20 seconds
- + 10° C for 15...19 seconds
- + 20° C for 14...18 seconds
- + 30° C for 13...17 seconds
- + 40° C for 12...16 seconds.

When the specified time has elapsed, the voltmeter must indicate 0 V.

Does voltmeter indicate 0V after specified time?

N>

Replace glow-duration control unit.

Check whether glow plugs glow when starting motor is activated. Connect voltmeter at R-type sheathed-element glow plug to ground. Position glow-plug and starter switch to Start position. Voltmeter must indicate 6...10 V. Voltage present?

N>

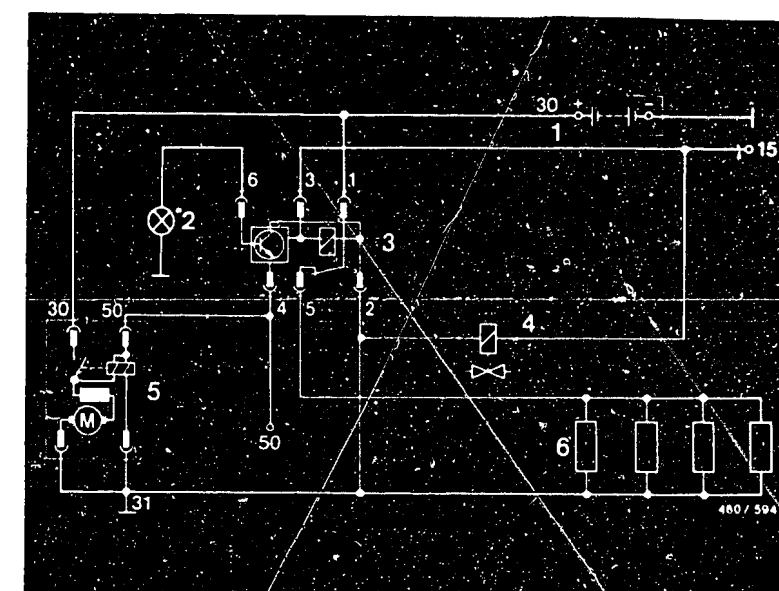
1. Test lead from glow-plug and starter switch term. 50 to glow-duration control unit term. 4 for open circuit. Eliminate open circuit.
2. If point 1 is O.K., replace glow-duration control unit.

Test R-type sheathed-element glow plugs. Test R-type sheath.-elem. glow plugs for cont. sep. using ohm. Does R-type sheath.-element glow plug have continuity?

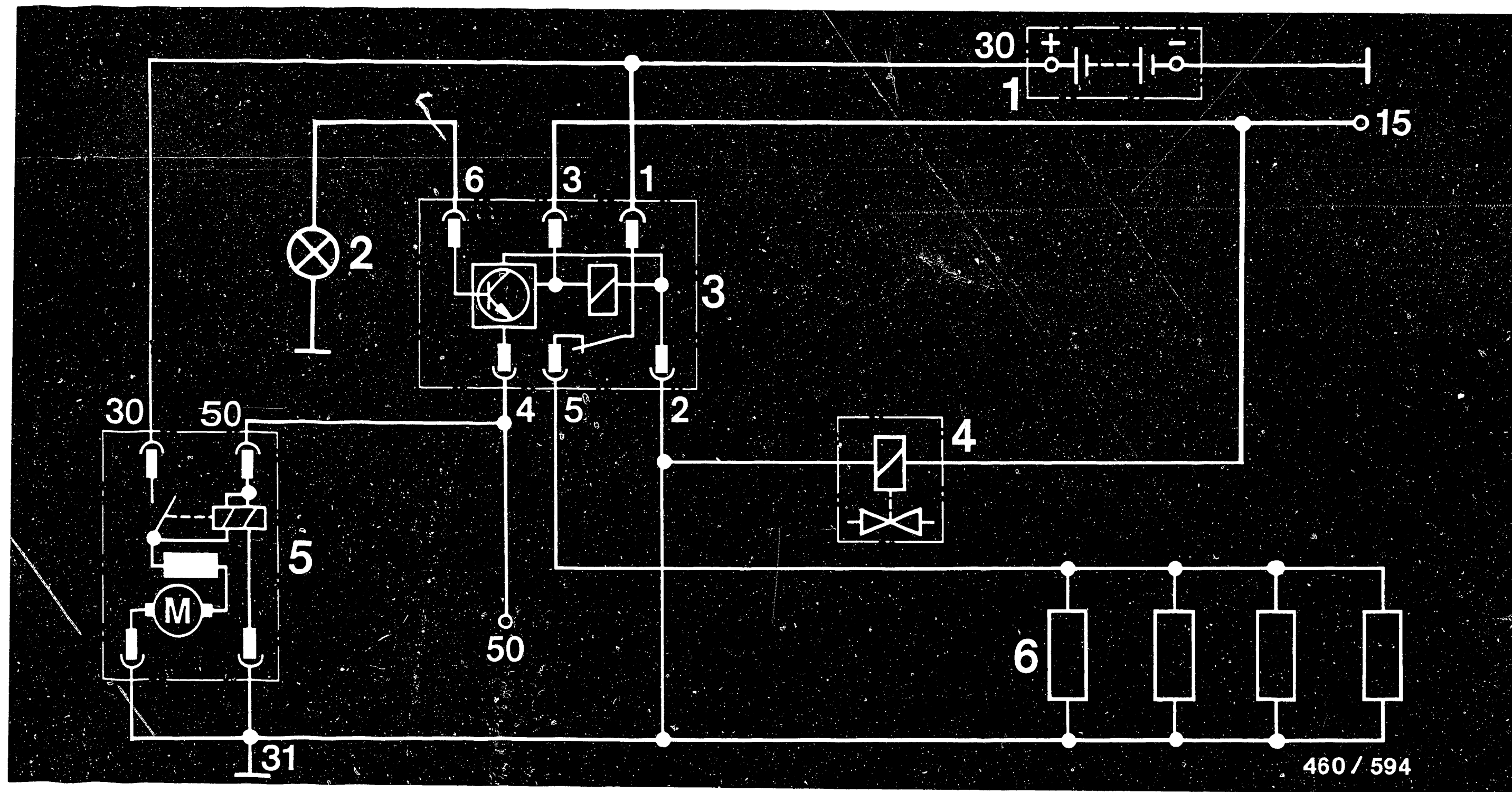
N>

Replace R-type sheath.-elem. glow plug

Preheating system O.K.



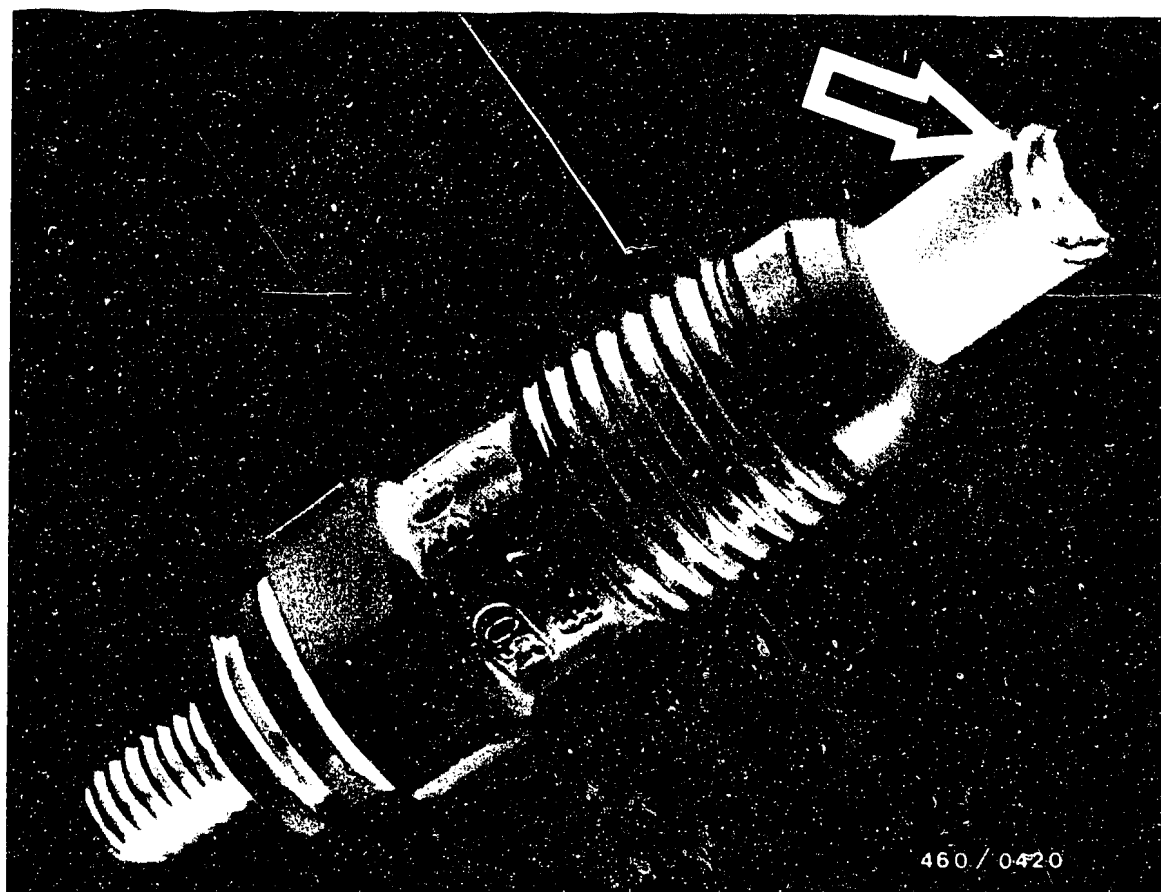
- 1 = Battery
- 2 = Preheating repeater lamp (12 V, 2 W)
- 3 = Glow-duration control unit
- 4 = Solenoid-operated valve
- 5 = Starting motor
- 6 = Sheathed-element glow plugs



TERMINAL DIAGRAM OF PREHEATING SYSTEM

1 = Battery
 2 = Preheating repeater lamp
 3 = Glow-duration control unit

4 = Solenoid-operat. valve
 5 = Starting motor
 6 = Sheath.-elem. gl.plugs

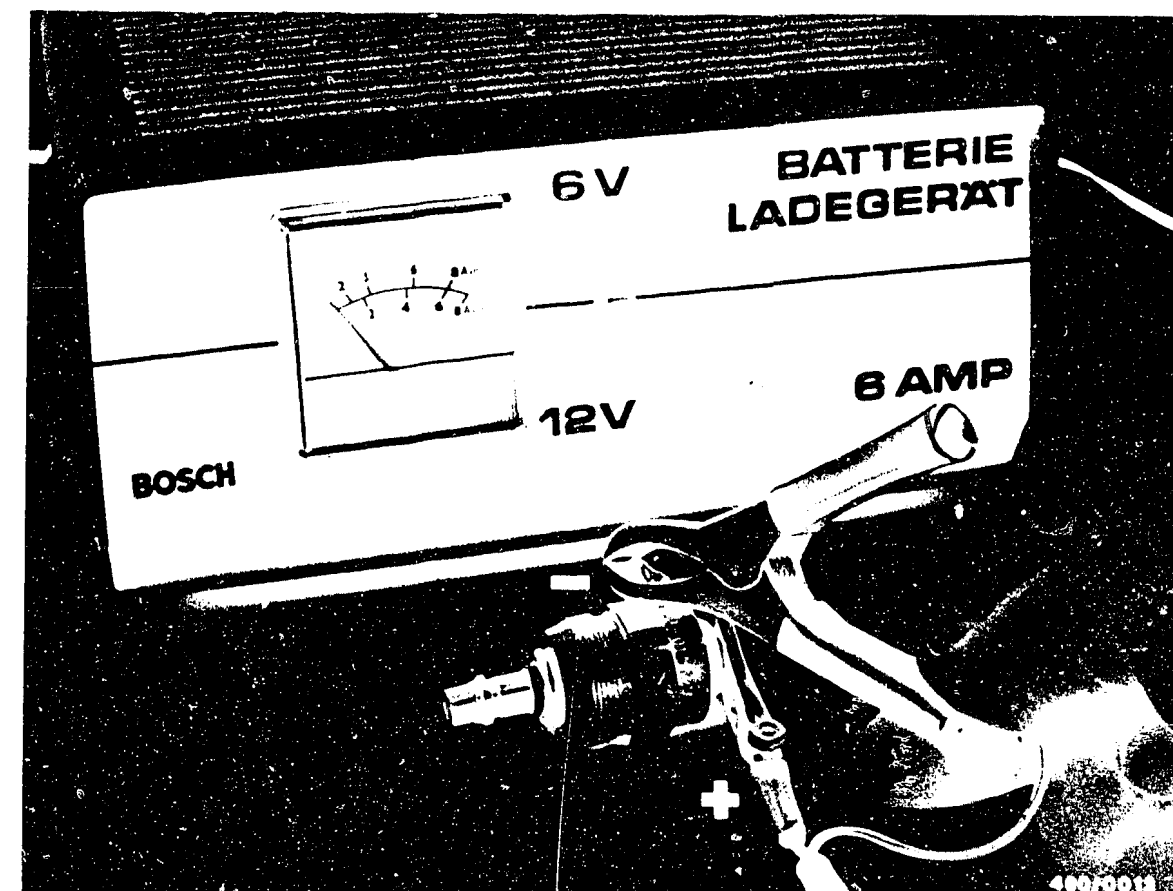


NOTE :

Glow plugs with burned sheathed elements are frequently the result of nozzle damage.

If a complaint is received and glow plugs damaged in this way are found (illustration, arrow), it is not sufficient to simply replace these plugs.

The injection nozzles must also be tested with respect to their spray pattern, chattering, pressure and leak-tightness.



TESTING EMERGENCY SHUTOFF DEVICE FOR CORRECT OPERATION

Engine does not start.

Test whether solenoid-operated valve is supplied with voltage (at least 10 V) when ignition is switched on.

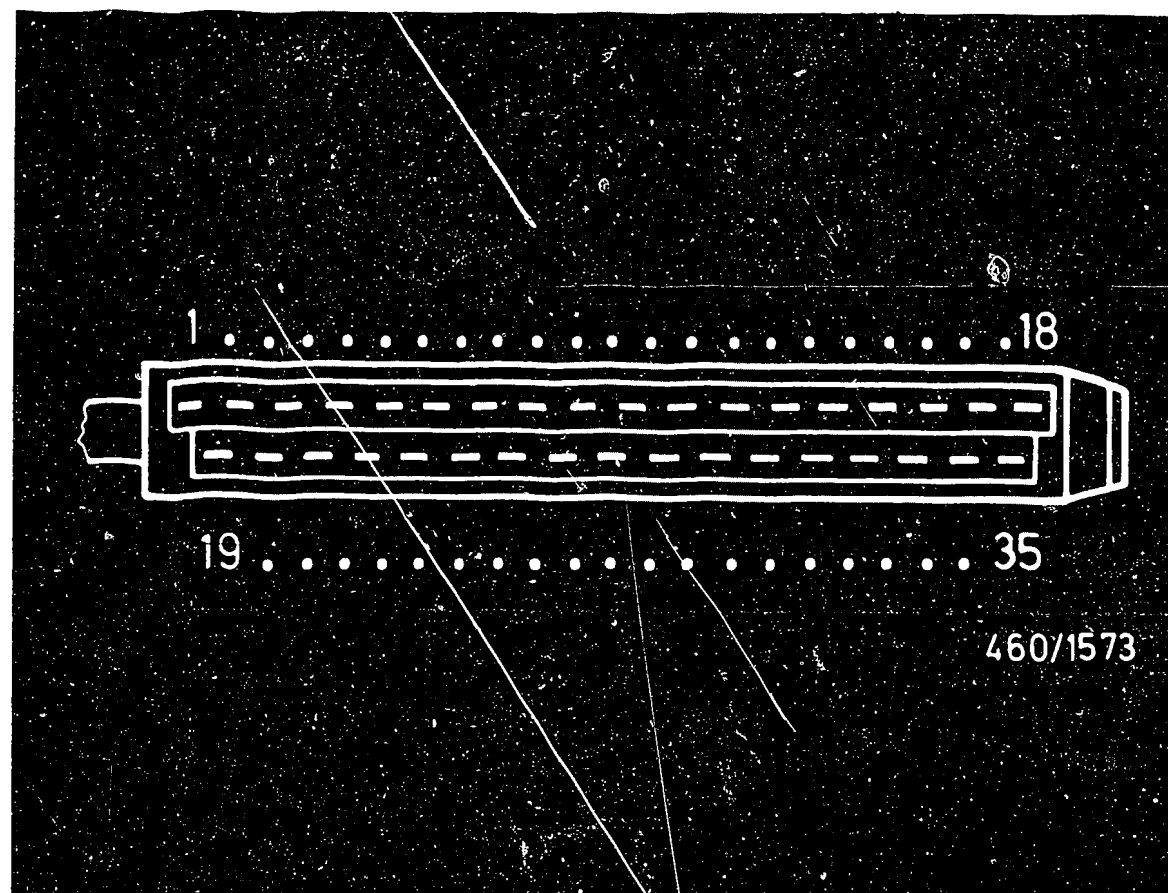
If voltage is available, remove solenoid-operated valve.

Make sure that everything is kept clean !

Test the solenoid-operated valve for correct operation while it is removed.

Note:

Solenoid-operated valve must be supplied with voltage only for a short time while removed, since there is no fuel to cool it.



No voltage at solenoid-operated valve:

Prerequisite:

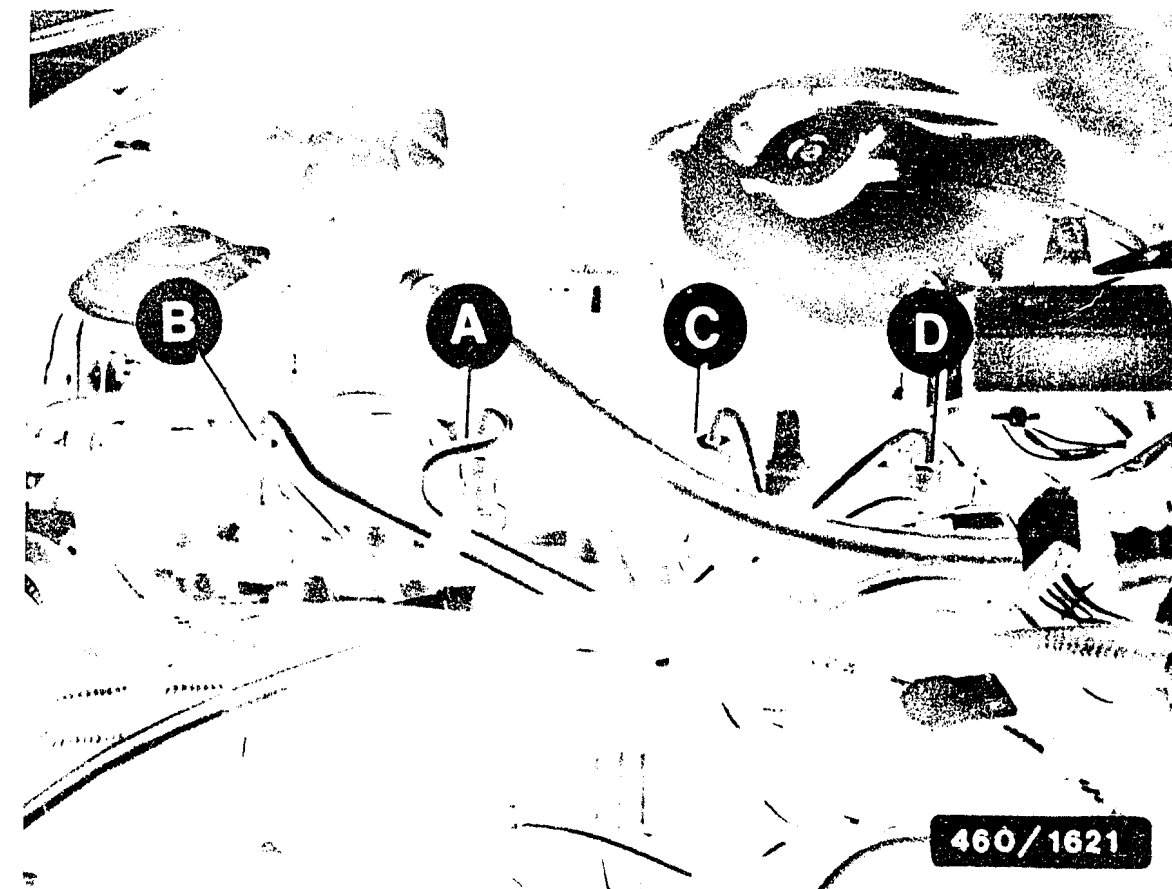
Delivery controller and rotational-angle potentiometer O.K..

Disconnect cable connector from control-unit plug 1.

* Test lead term. 4 from control-unit plug 1 to solenoid-operated valve for open circuit.

Eliminate open circuit.

* If there is no open circuit, replace control unit 1.



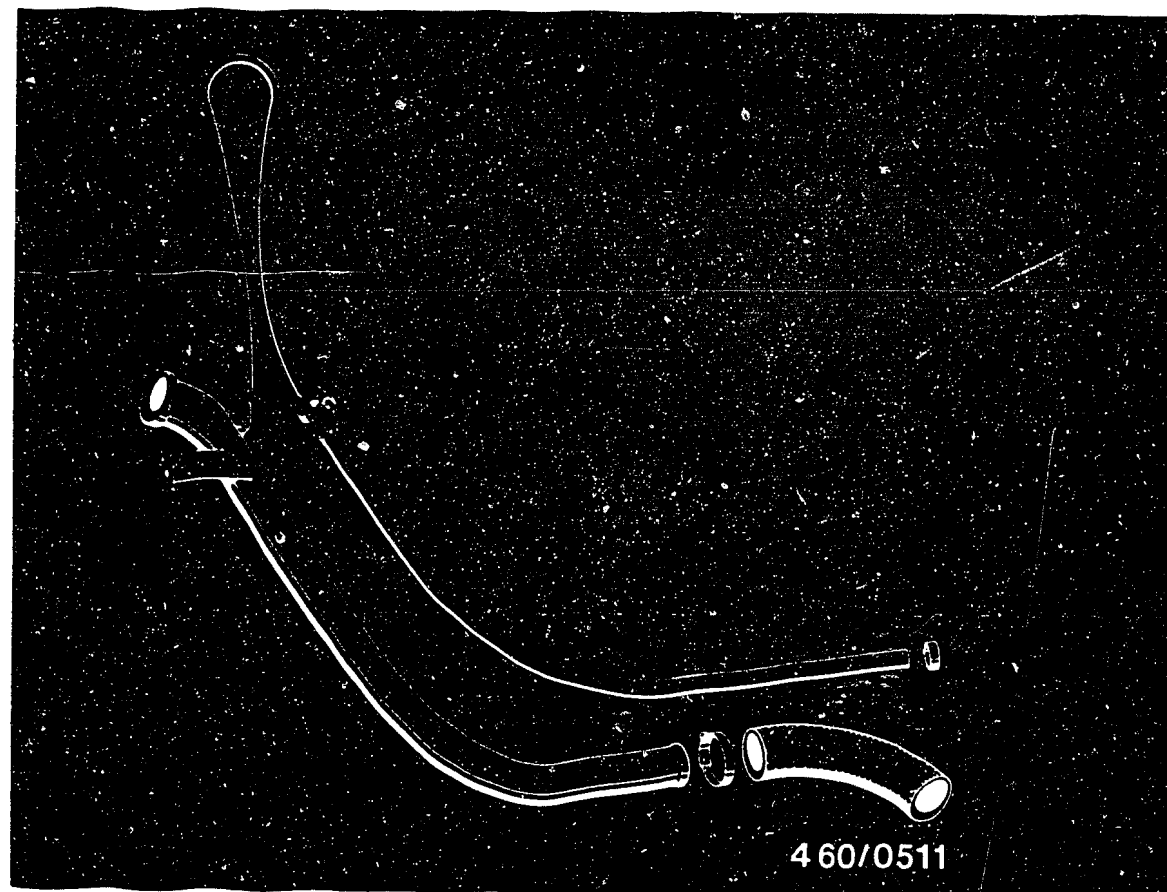
CHECKING LAYING OF FUEL-INJECTION TUBING

The fuel-injection tubes are connected to each other by clamps so that it is impossible to mix up the outlets.

If, however, there is still uncertainty, check the laying of the tubing in accordance with the illustration above.

Assignment of the fuel-injection-pump outlets to the individual cylinders of the engine is marked by the letters A to D.

Return to trouble-shooting chart B04.



CHECKING THE TANK VENTILATION

Open the fuel-tank filler inlet cap.

If the fault no longer occurs after opening the filler inlet cap, the tank ventilation is defective.

Remove the hose lines of the tank ventilation (illustration) and check for clogging or constriction.

If necessary, check the fitting at the tank.

Return to trouble-shooting chart B04



1 = Bleeder screw

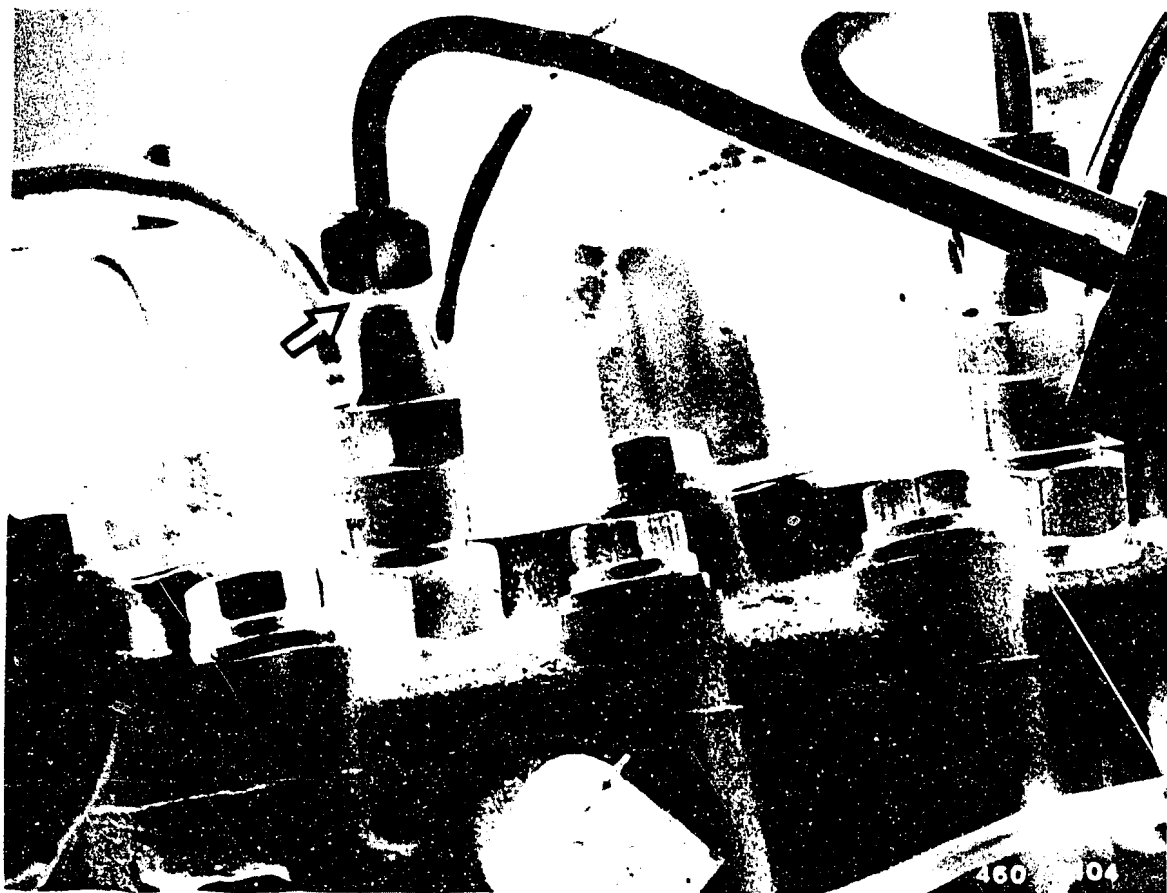
2 = Hand pump

BLEEDING THE FUEL SYSTEM

Loosen the bleeder screw and actuate the handpump until bubble-free fuel escapes at the bleeder screw.

Re-tighten the bleeder screw.

Continue to actuate the hand pump until resistance becomes noticeable.



Loosen the union nuts of the fuel-injection tubes at the injection-nozzle-holder assemblies (see illustration, arrows).

Actuate the starting motor of the engine without preheating until fuel escapes at the union nuts of the injection-nozzle-holder assemblies.

Tighten the union nuts.

Actuate the starting motor until the engine starts.

Return to trouble-shooting chart B04



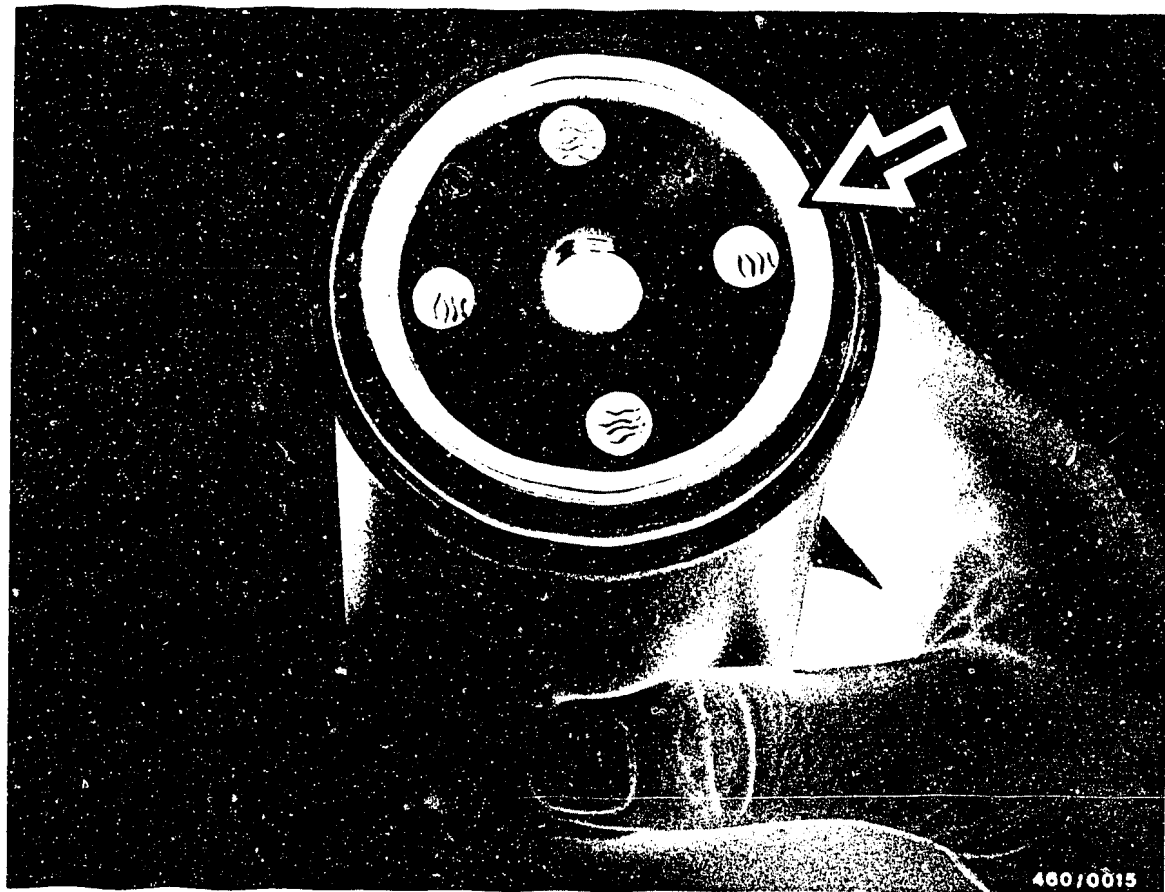
REPLACING AND DRAINING WATER FROM THE FILTER BOX

Replacing the filter box.

Unscrew the fuel filter (see illustration, arrow) from the filter cover.

Loosen the tight-fitting filter box using special wrench e.g. Matra W 167.

Catch any fuel which escapes.



Coat the rubber gasket (see illustration, arrow) of the new filter box with diesel fuel.

Screw the filter box into the cover by hand and tighten.

Test the fuel filter for leakage.

In the case of winter fuel, if necessary, admix gasoline in accordance with the specifications of the vehicle manufacturer.



Draining the fuel filter of water.

Loosen the bleeder screw (arrow) at the filter cover by several rotations.

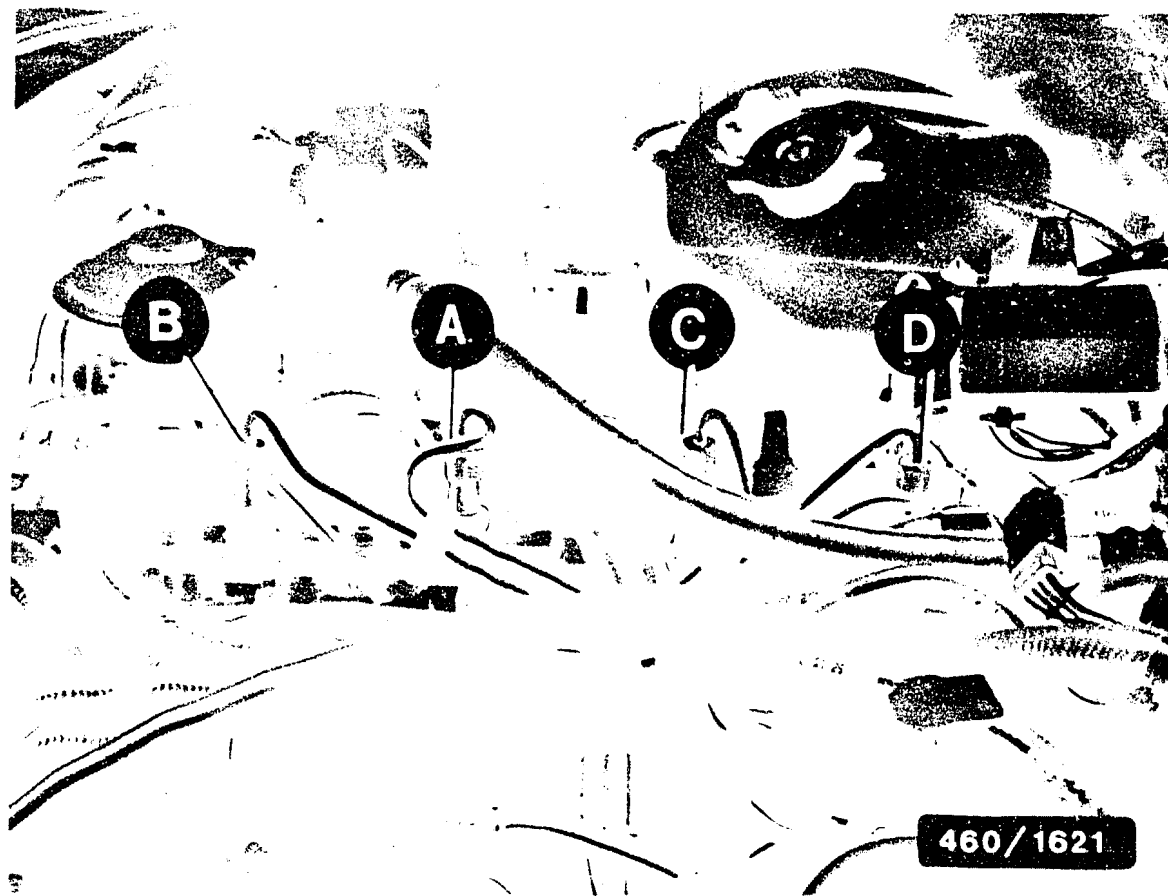
Loosen the water drain screw at the bottom of the filter and allow the water to drain off.

Catch the fluid in a container.

Tighten the water drain screw and bleeder screw and test for leaks.

If necessary, bleed the fuel filter of air.

Return to trouble-shooting chart B04



TESTING THE FUEL-INJECTION SYSTEM FOR LEAKS

Carry out leakage test with engine at normal operating temperature.

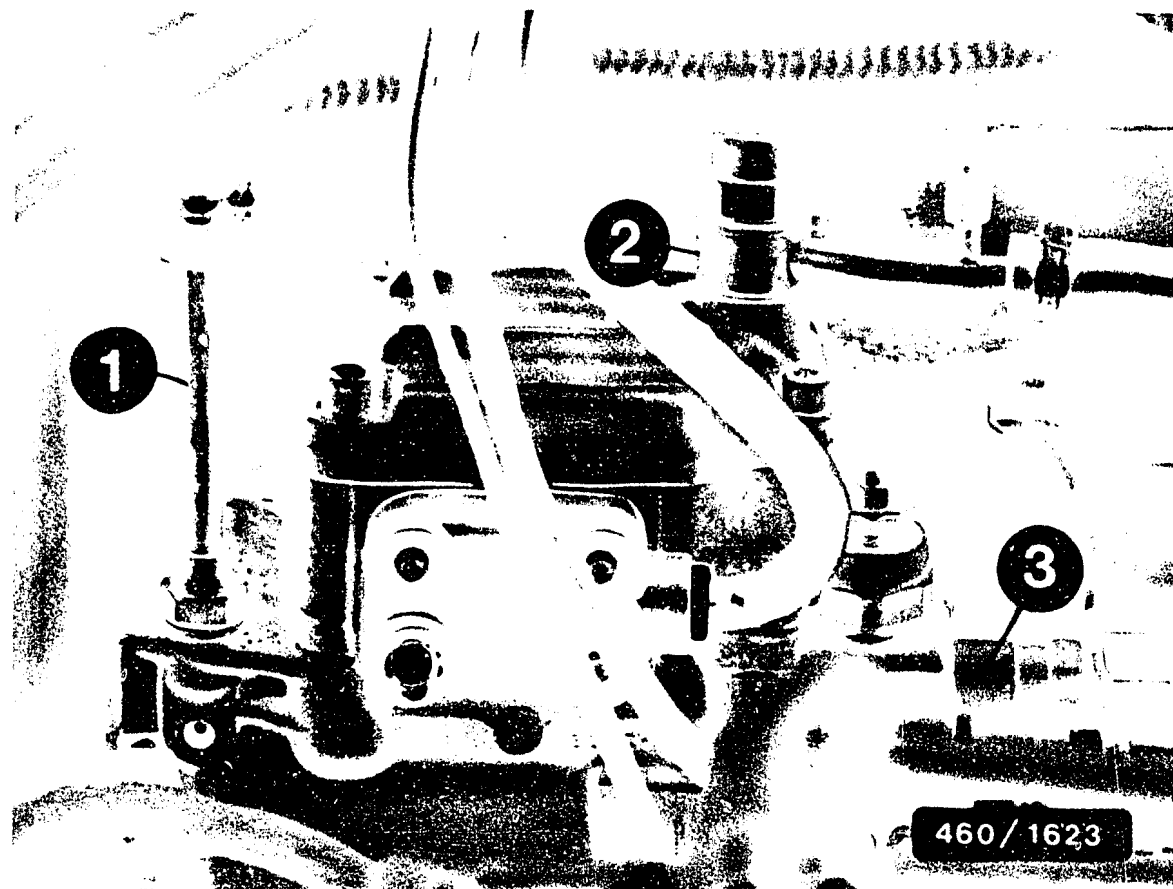
Check all connecting points of the fuel lines.

Pay particular attention to:

- * Connection at the injection-nozzle-holder assembly (A...D).



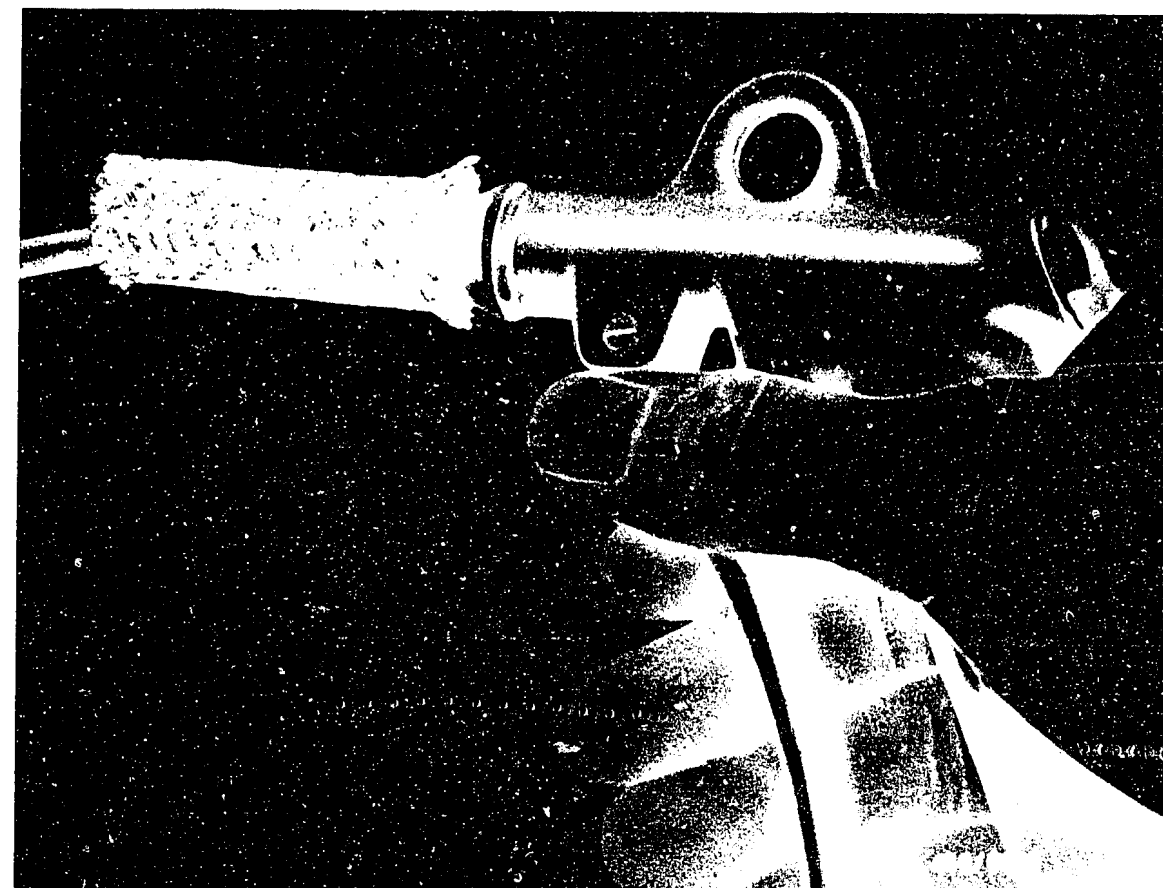
- * Connections at the fuel filter (see illustration, arrows).



- 1 = Fuel inlet line
- 2 = Fuel return line
- 3 = Delivery-valve holder

- * Fuel inlet line and return line at the distributor-type fuel-injection pump.
- * Delivery-valve holder on the hydraulic head.

Examine fuel lines for hairline cracks.



CHECKING THE FUEL LINES

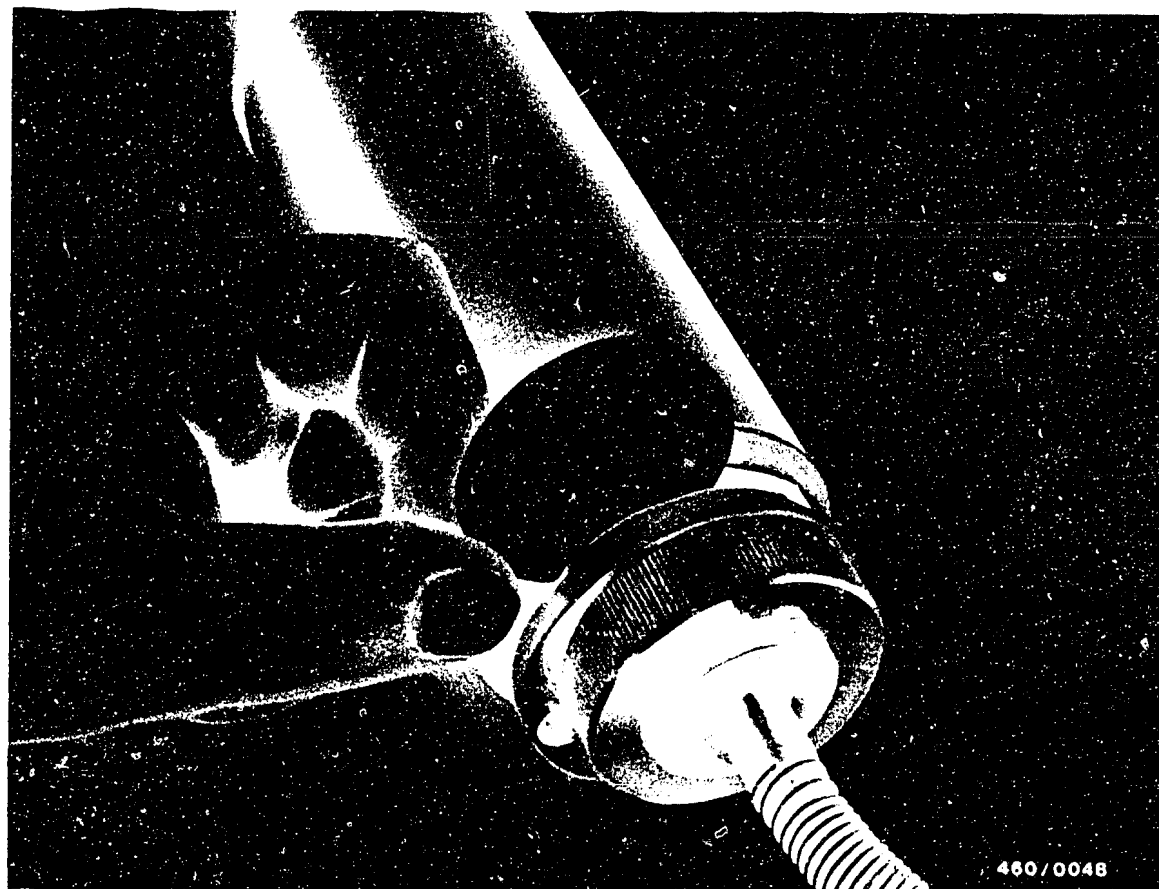
Carry out a visual examination of the fuel lines about which a complaint has been received.

If pinched or kinked locations cannot be found, remove the fuel line suspected of being defective.

Check the fuel line for throughflow using compressed air and clean if necessary.

A suitable hose piece may be used as a side seal for blowing out the fuel lines.

Return to trouble-shooting chart B04



SMOKE TEST - CHECKING AIR FILTER

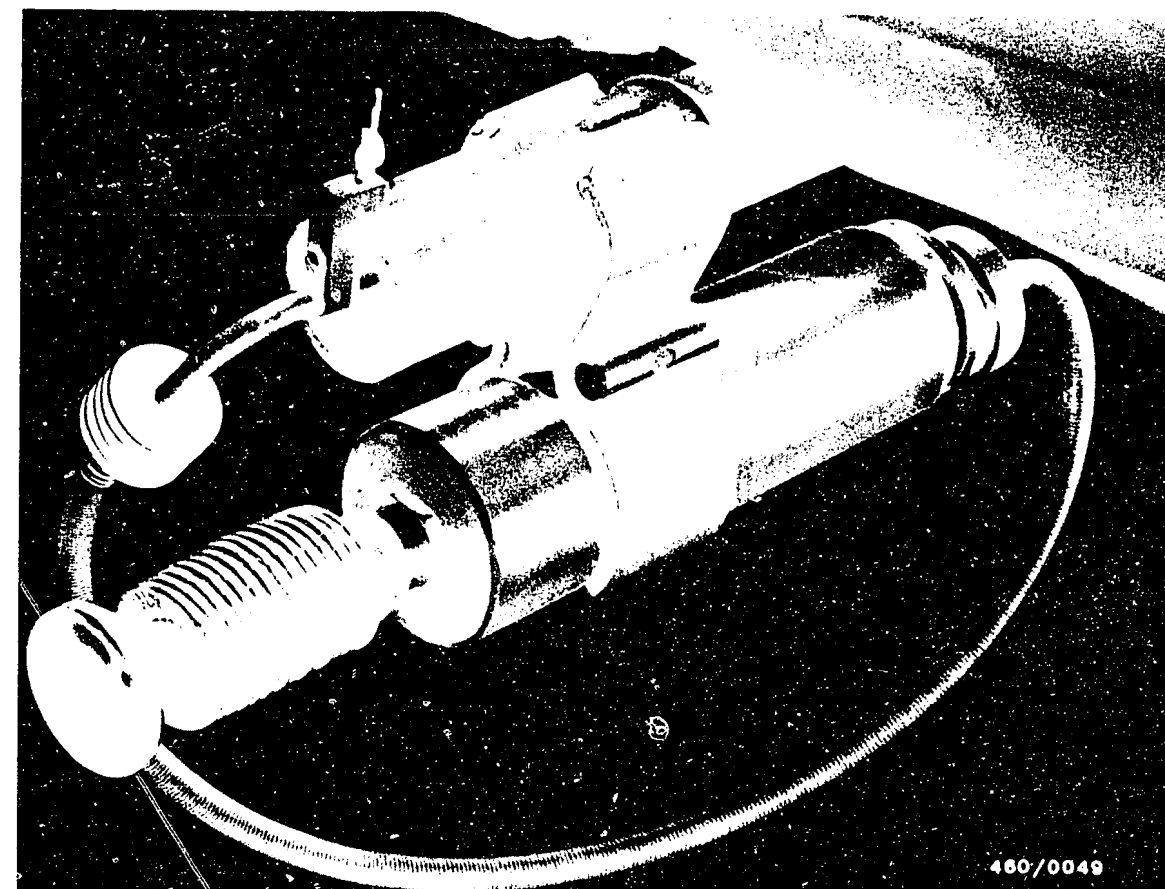
Test setup

The smoke test is conducted using the Bosch filter-type smokemeter.

The filter-type smokemeter consists of the following units:

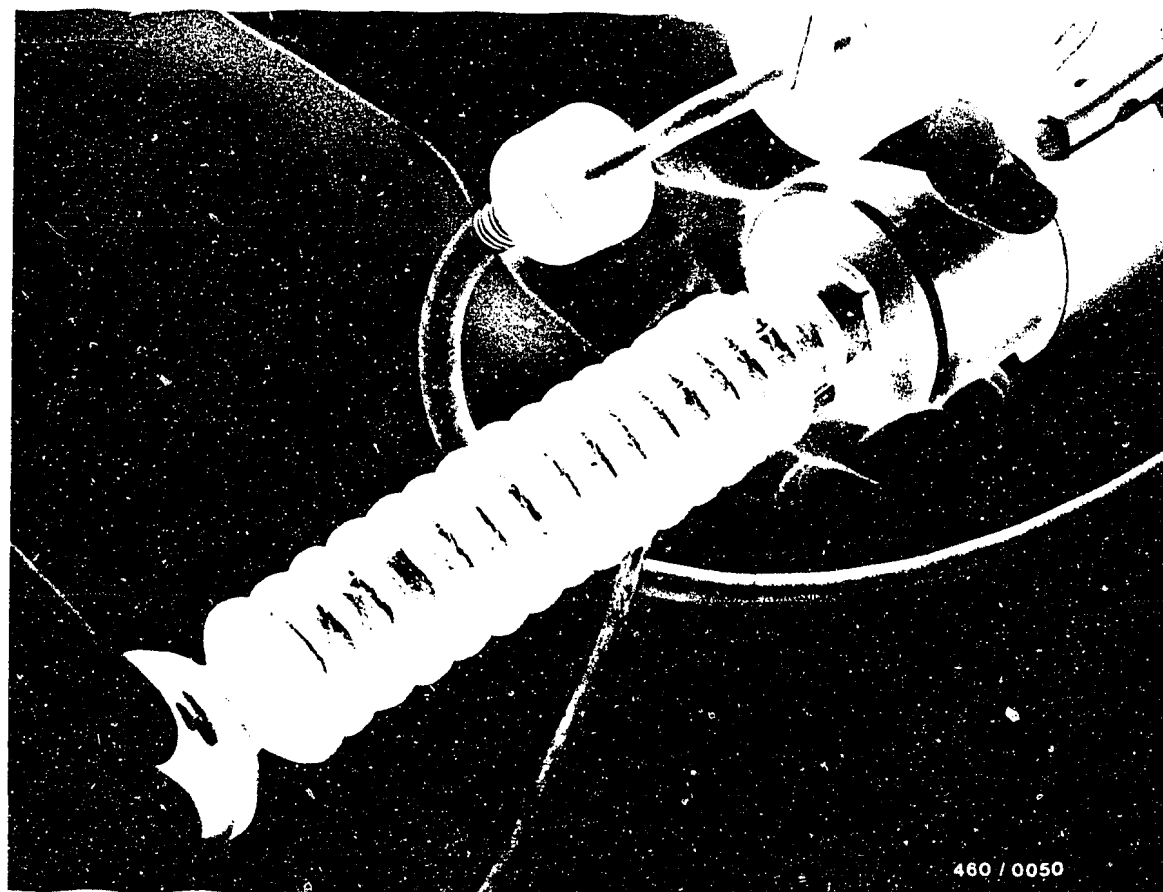
- * Accessories box with proportioning pump 0 681 169 038
or 0 681 169 058
- * Evaluating unit 0 684 102 050

Insert filter plate into proportioning pump
(for filter-type smokemeter 0 681 169 038).



Mounting respective sampling pump on exhaust pipe using appropriate clamp.

Introduce exhaust-sample pickup as far as possible into exhaust pipe and clamp in position.



Measurement in accordance with the equilibrium method

Set the proportioning pump by pressing in the black push-button.

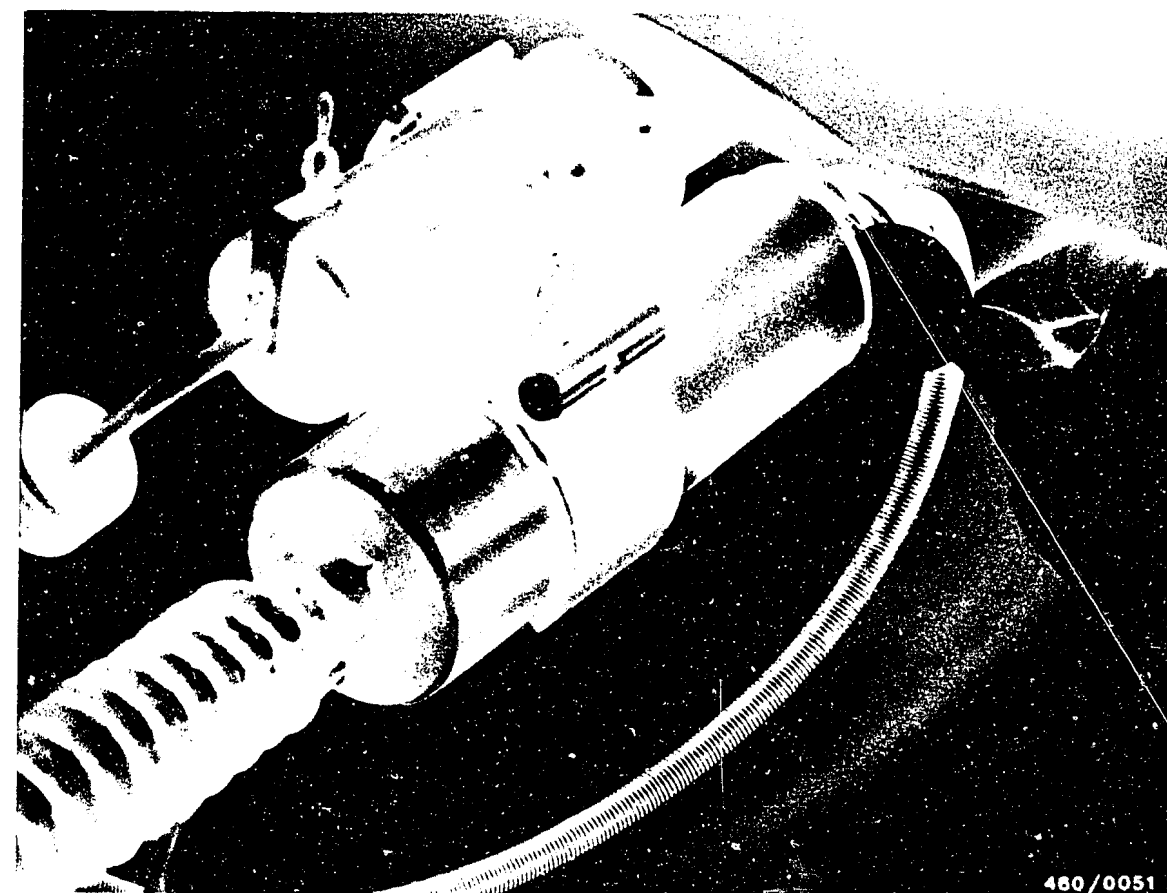
Take rubber ball on triggering hose and enter passenger compartment.

The test can be performed on the chassis dynamometer or on the road (gradient).

The chassis dynamometer is preferable in any case.

Find the gear in which, with the accelerator pedal in the full-load position, a speed of approx. 40 km/h is reached.

Load the engine so that, with the accelerator pedal in the same position, a speed of approx. 25 km/h is reached.



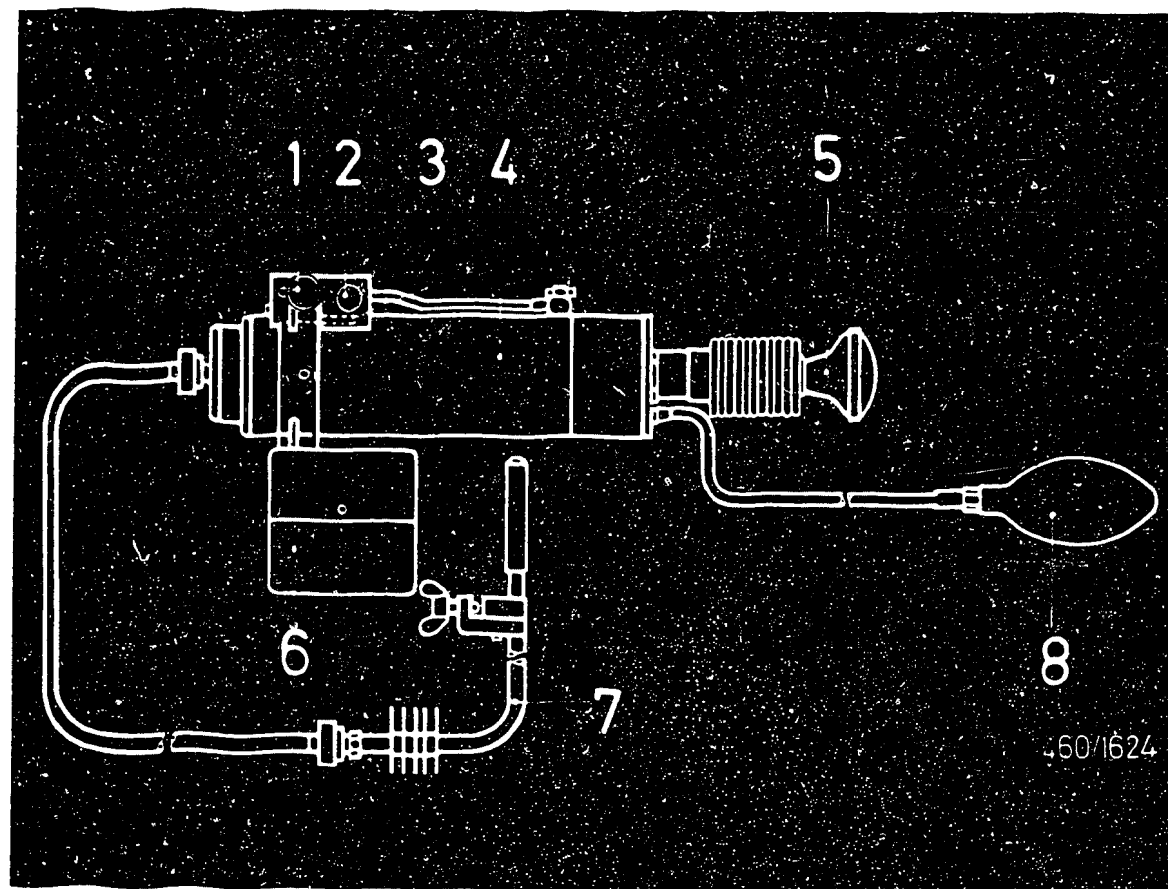
Maintain this load condition for 5 seconds and then trigger the proportioning pump by pressing the rubber ball.

Switch off the engine.

C A U T I O N !

During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

Remove the filter plate from the sampling pump.



- 1 = Rotary knob for paper transport
- 2 = Push-button for actuation by compressed air
- 3 = Compressed-air connection
- 4 = Proportioning pump
- 5 = Trigger for manual actuation
- 6 = Magazine for filter-paper roll
- 7 = Exhaust-sample pickup
- 8 = Rubber ball

Measurement in accordance with the acceleration method
in conjunction with the filter-type smokemeter
0 681 169 058.

Operating the proportioning pump:

The plunger of the proportioning pump can be positioned to the working position either by hand or by means of compressed air.

There is a corresponding connection (3) and a push-button (1) available for actuation by compressed air.

Clamp the proportioning pump.

Test requirement:

Taking into consideration the handling and manual operation, we recommend that measurements not be carried out in the open air if it is raining or if the air temperature is below 0° C.

When carrying out the test, the engine must be at normal operating temperature (coolant temp. at least 60° C).

A T T E N T I O N !

During the following operations, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

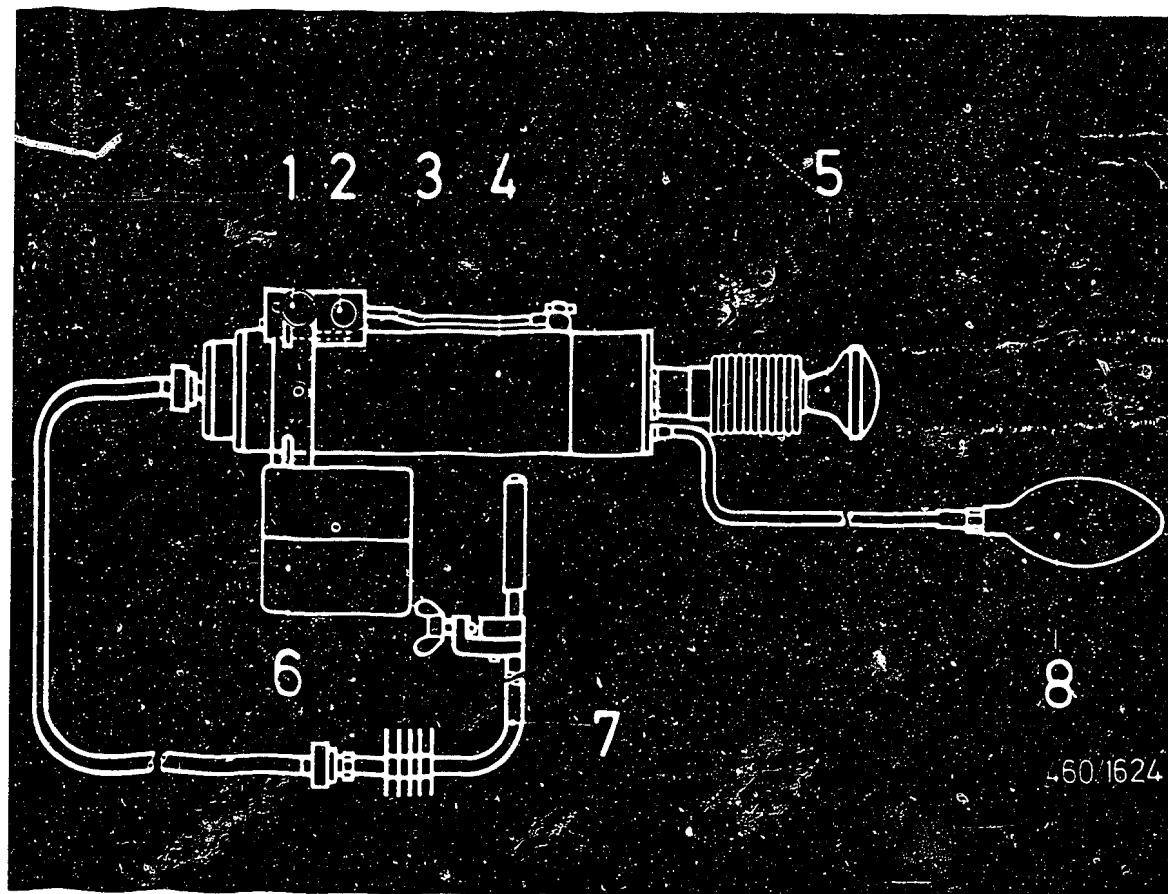
Test procedure:

To clean the exhaust system, accelerate the engine immediately before measurement to its breakaway speed at least three times in rapid succession.

Approx. 1 second before accelerating for the 4th time, trigger the induction stroke of the proportioning pump by pressing the rubber ball.

Afterwards, stamp the accelerator pedal fully to the floor until the maximum speed of the engine is reached and the fuel-injection pump governor regulates.

When the breakaway speed is reached, release the accelerator pedal immediately (idle position).



- 1. = Rotary knob for paper transport
- 2 = Push-button for actuation by compressed air
- 3 = Compressed-air connection
- 4 = Proportioning pump
- 5 = Trigger for manual operation
- 6 = Magazine for filter-paper roll
- 7 = Exhaust-sample pickup
- 8 = Rubber ball

By actuating the push-button (2), the piston is returned to the working position (when testing with compressed-air supply).

Hold the push-button down until latching has occurred.

Transport the filter paper one knotch further by turning the rotary knob (1) (releasing and applying tension to the filter paper is performed automatically).

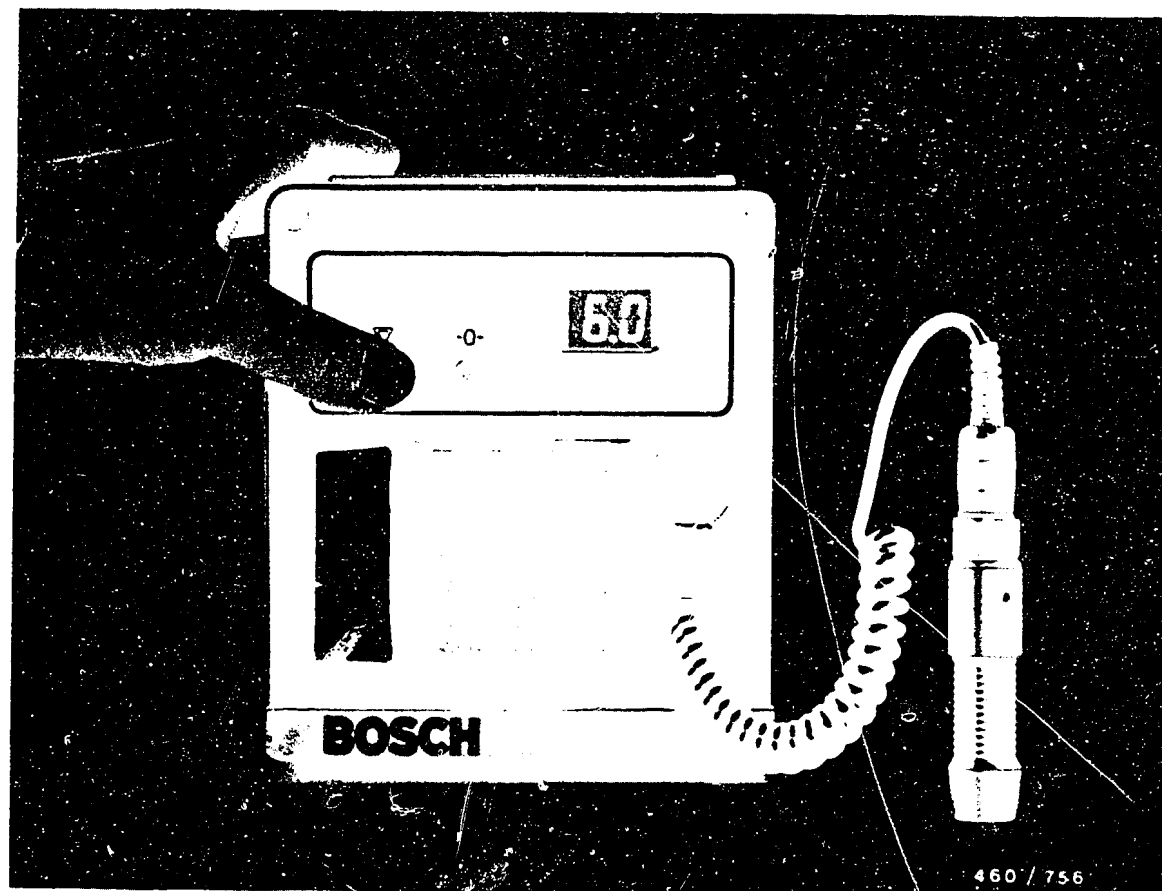
Repeat the measurement three times.

Position the plunger to the working position and tear off the measuring tape covered in soot.

For the acceleration measurement, take as many individual measurements as are required until three successive smoke numbers are obtained which do not deviate from each other by more than 1 Bacharach unit.

Note:

In the case of engines with selectable supercharging, the complete series of measurements must be taken with supercharging selected.



Evaluation of the filter plate

Perform zero point adjustment on the evaluating unit.

The zero point adjustment must be performed

- * before each series of measurements
- * if there are changes in the ambient conditions
- * whenever the lens of the photo-element adapter has been cleaned.

Firmly press the measuring head of the photo-element adapter on to 5 clean white filter plates placed one on top of the other.

Press button "0" until display 0.0 appears. Release button "0".

Measuring

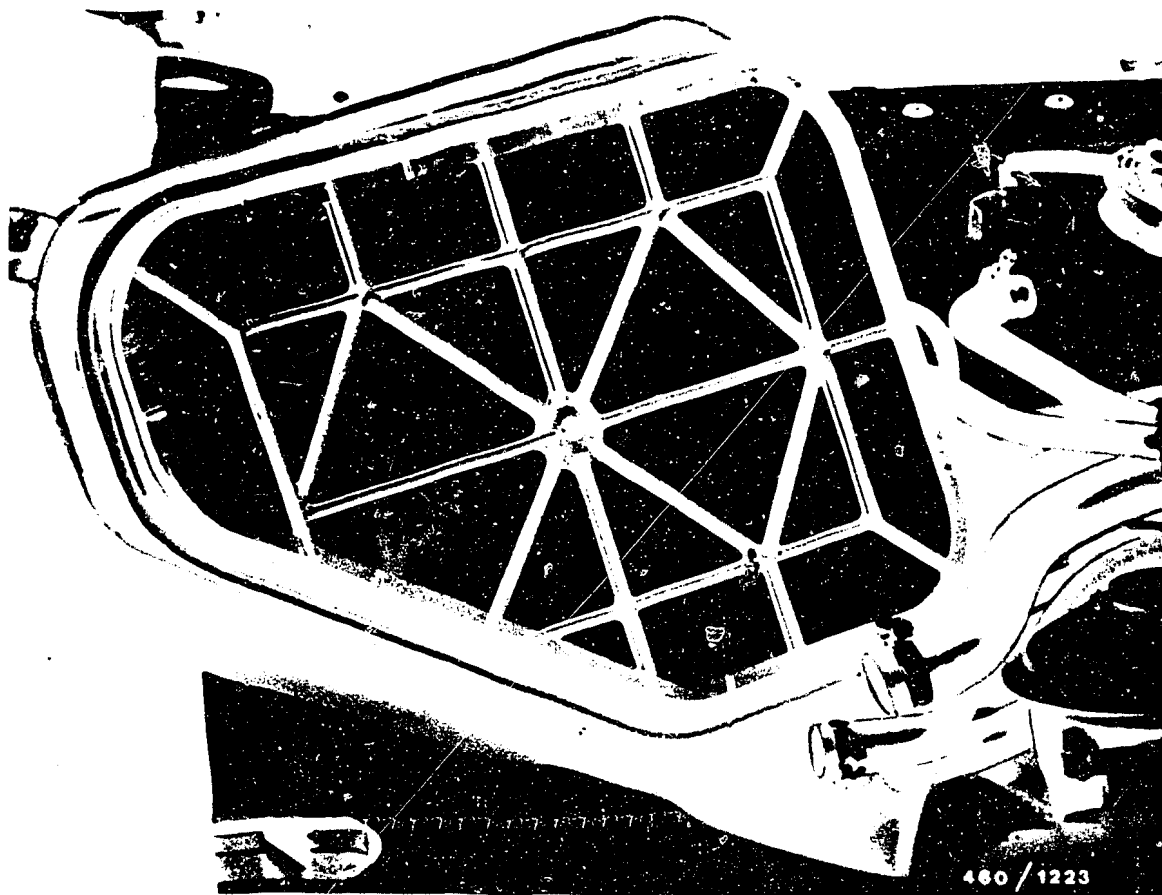
With the sooted side facing upward, place filter plate from metering unit on 3 new filter plates placed one on top of the other.

Press measuring head vertically on to black surface of the filter plate. At the same time, press button "C" until the smoke number measured appears on the display.

Note:

Measuring head must be firmly mounted both for the zero point adjustment and for measuring (even slight tilting may lead to incorrect measurement).

Determine the smoke number measured with the evaluation sheet. Note kW (bhp) information of vehicle manufacturer.



Check the air filter

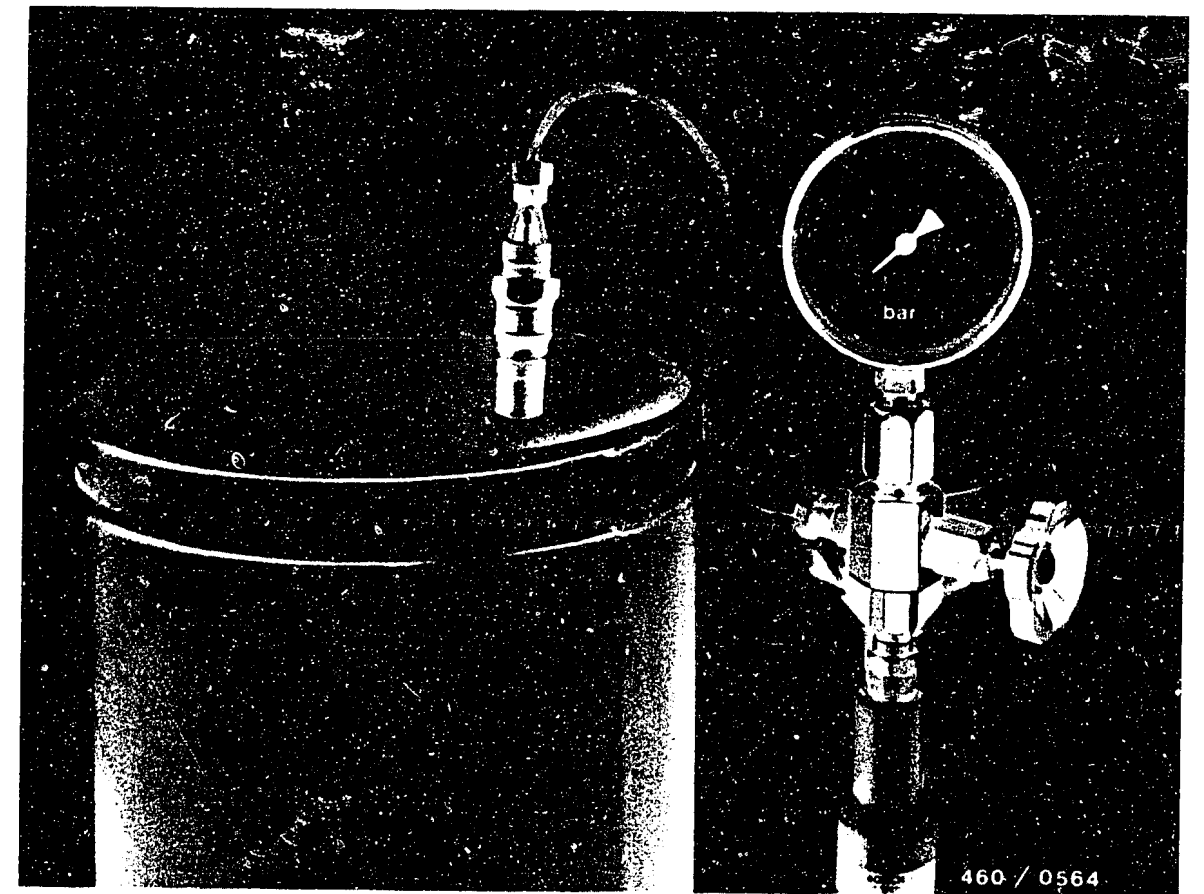
Remove the air filter and carry out a visual examination.

Test criteria for air filter:

- * dusty air filter
(test by knocking out air filter)
- * oil-fowled air filter
- * solid matter in air filter, e.g. leaves.

If in doubt, use a new filter element.

Return to trouble-shooting chart B04



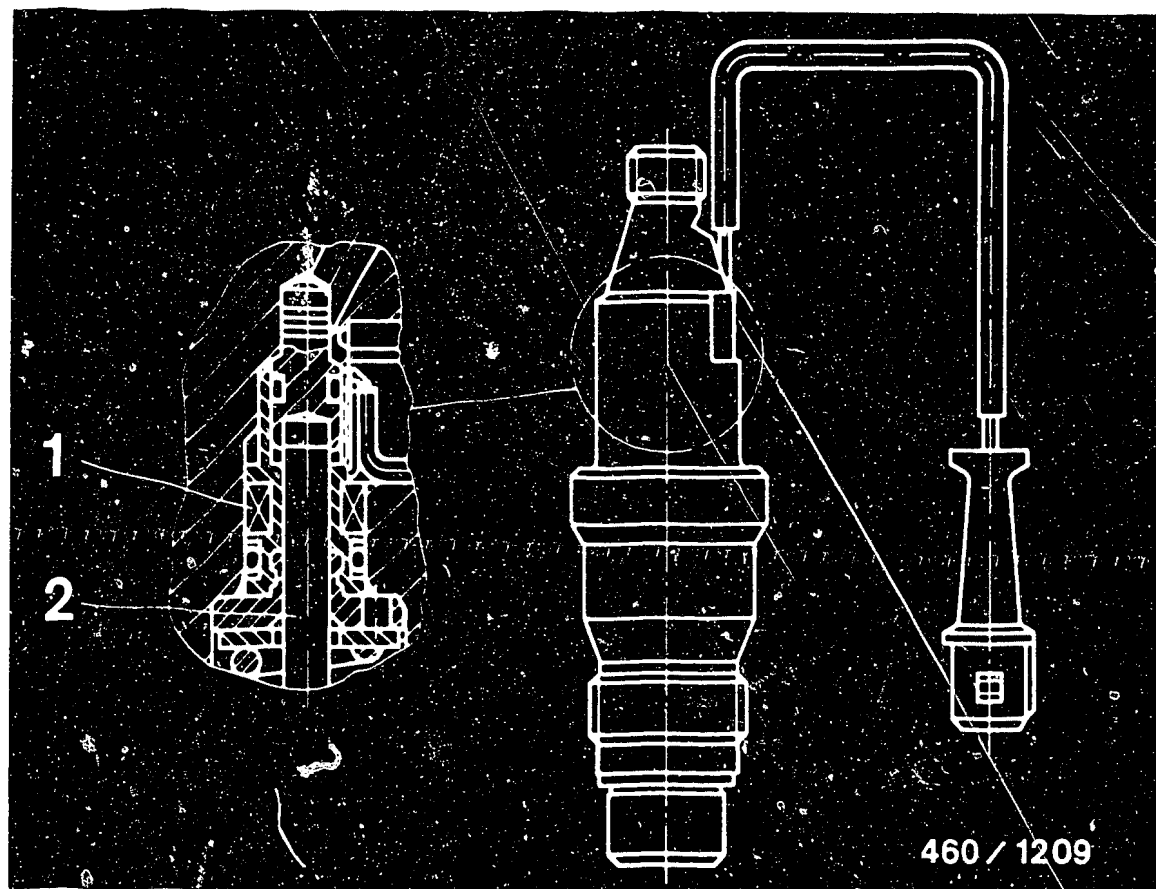
TESTING THE INJECTION NOZZLES

Remove the injection nozzles.

The test is performed using the nozzle tester EFEP 60 H, 0 681 200 502.

Mount injection nozzle with nozzle-holder assembly on the nozzle tester.

In order to ensure that the nozzle is not incorrectly clamped, vigorously actuate the hand lever of the nozzle testing device a number of times with the pressure gauge switched off (approx. 4 to 6 downward movements/second).



1 = Needle-movement sensor
2 = Pressure spindle

Nozzle-holder assembly with inductive needle-movement sensor (cylinder 2).

Only correction of the opening pressure is allowed to be performed by the After-Sales Service.

For this purpose, use special adjusting shims (larger diameter of central bore).

If any parts of the nozzles are defective, replace the nozzle-holder assemblies as complete units.

N o t e :

If parts of the nozzles are exchanged, this changes the signal voltage of the pickup coil and results in incorrect evaluation by the start-of-injection control unit.

Notes:

When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into the skin and may cause blood poisoning.

For testing, use pure calibrating oil to ISO 4113 or clean diesel fuel.

Test criteria: * Opening pressure
* Leakage
* Chatter behavior
* Spray pattern

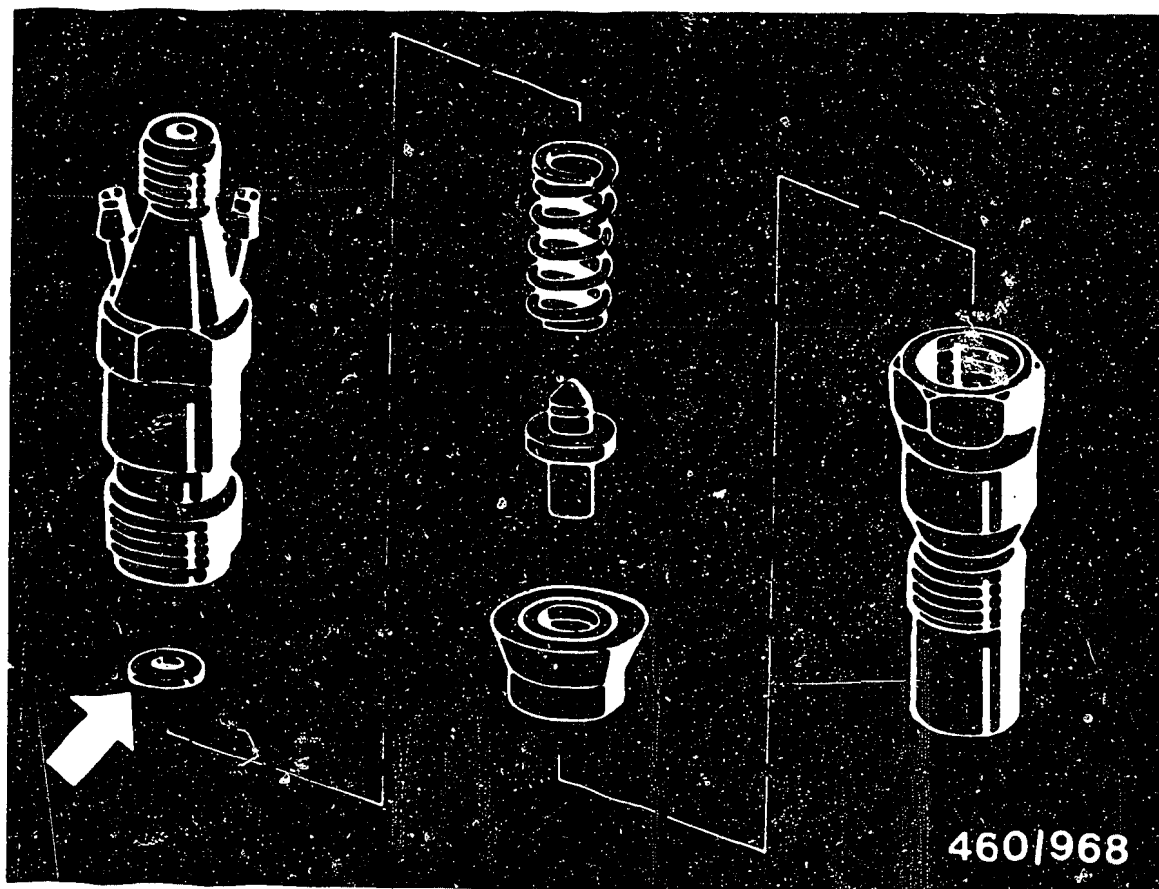
Test the opening pressure

Open the spray-off valve at the pressure gauge approx. 1/4 rotation.

Slowly push down the hand lever of the nozzle tester (pressure increase at pressure gauge).

Observe the pressure at which the pointer of the pressure gauge maintains a steady position (nozzle does not chatter) or the pressure drops suddenly (nozzle chatters).

The highest pressure reached during this test is the opening pressure.



If different from the set value, correct the nozzle-opening pressure by means of shims behind the pressure spring in the nozzle holder.

See brief instructions for set value.

Thicker shims = higher nozzle-opening pressure
Thinner shims = lower nozzle-opening pressure.

A ± 0.05 mm change of the spring travel results in a change of the nozzle-opening pressure of approx. 5.0 bar.

Leakage test

Open the shutoff valve on the pressure gauge approx. $1/4$ rotation.

Dry off the lower part of the nozzles and of the nozzle-holder assembly (blow dry with air).

Slowly push down the hand lever until the pressure gauge indicates 20 bar less than the opening pressure read off previously.

The nozzle is leak-tight if no drop falls from the mouth of the nozzle within a period of 10 seconds.

If a drop does fall, disassemble and clean the nozzle-and-holder assembly.

If the nozzle continues to leak, replace it.

Reworking nozzle components is not permissible.

Note:

Scoring on the supporting device and intermediate disc may be reworked, with necessary care being taken (during the warranty period).

Chatter and spray tests

The nozzles in question are pintle nozzles with throttling effect, which are installed in all engine types.

The bottom of these nozzles has a special shape and an additional spray hole through which the pilot spray is ejected.

Chatter test:

Thanks to its special structural features, this nozzle chatters very softly.

With this nozzle, the chatter test is possible only when there are between 1...2 downward movements of the hand lever per second.

If the test speed is increased, chattering ceases.

The calibrating oil then escapes from the nozzle producing a hissing noise.

The nozzle chatters with a high whistling tone only when the hand lever is moved rapidly and jerkily (approx. 4...6 downward movements per second).

Spray pattern: (applies to new nozzles only)

At low test speed, the largest part of the quantity delivered must be well atomized and be sprayed out through the side pilot-spray hole without heavy streaking.

Assessment of the main spray is possible only when the hand lever is operated quickly (approx. 4...6 downward movements per second).

The spray must be concentrated and well atomized.

Chatter test, assessment of the spray pattern

General:

When assessing the nozzles, differentiation must be made between new and used nozzles.

Switch off the pressure gauge.

New nozzles:

The chatter test makes it possible to audibly test the freedom of movement of the needle valve in the nozzle body.

If the nozzle does not chatter despite having been cleaned, it must be replaced by a new nozzle.

The spray pattern is of no relevance for the chatter test.

Generally speaking, only new nozzles deliver a correct spray pattern.

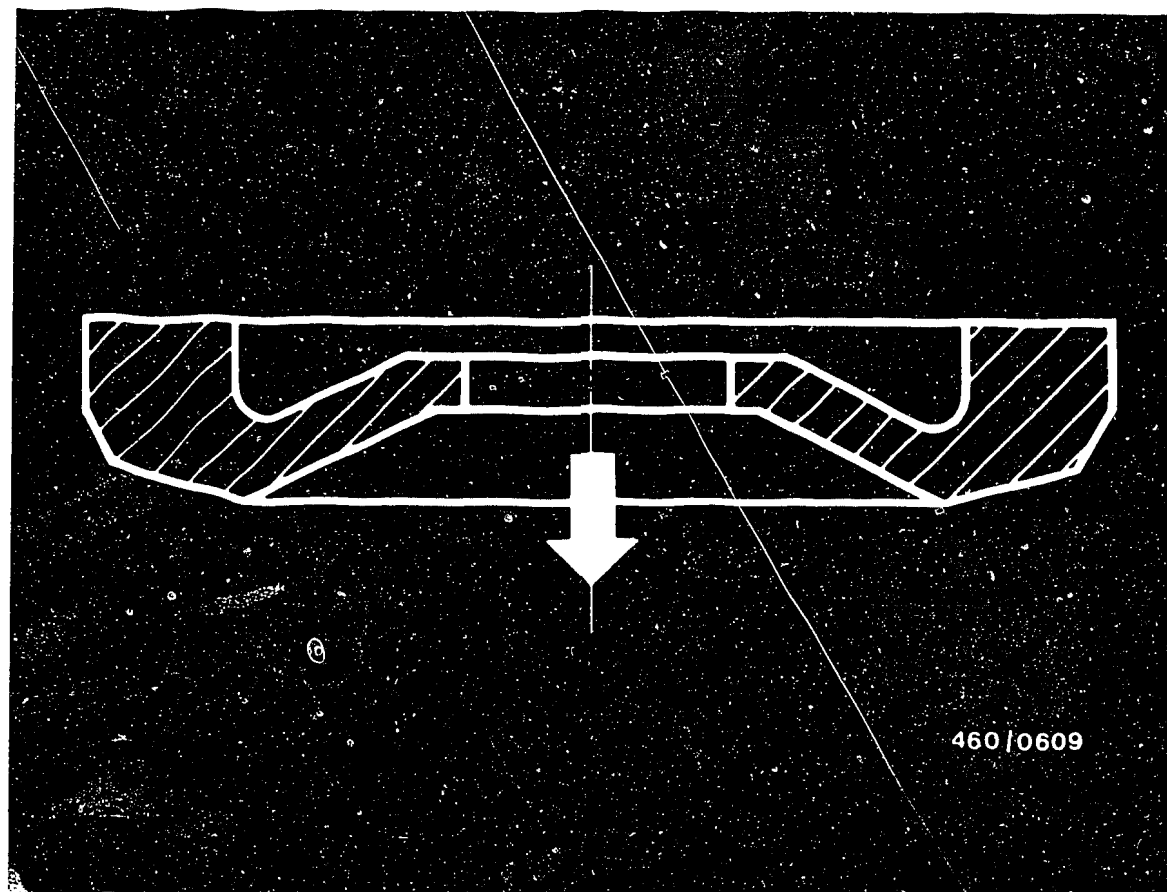
Used nozzles:

Due to wear in the seat area of the nozzles, the chatter behavior of the nozzles deteriorates.

With quick actuation of the lever, the nozzles must chatter so that they can be heard and/or deliver a well atomized spray.

The spray pattern of used nozzles may deviate from the ideal pattern of a new nozzle.

If suitable cleaning measures are taken, the spray pattern of such nozzles may be noticeably improved.



Installing the injection nozzles

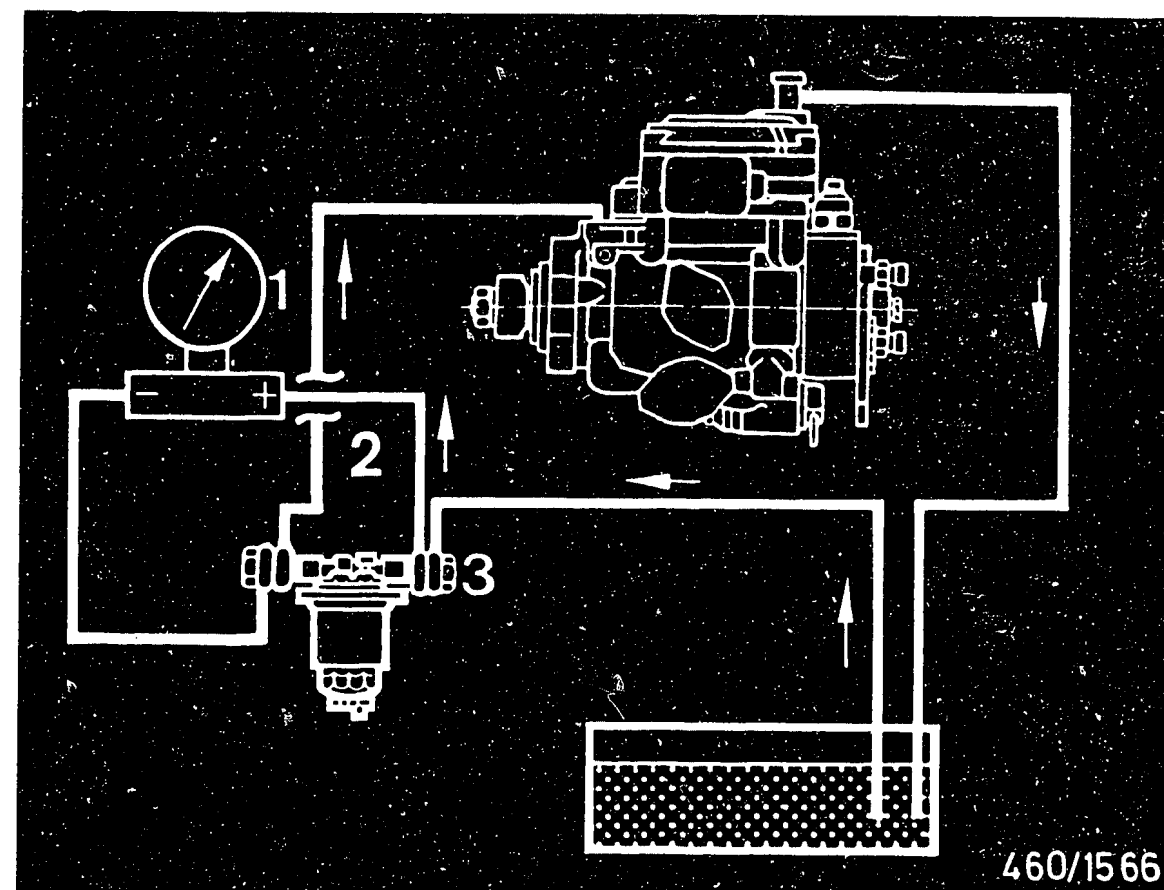
Before installing the injection nozzles, insert a new heat seal into the cylinder head the right way round, for the purposes of shielding and compensating tolerances (sealing cone 150° in the direction of the arrow).

Following this, screw the nozzle-holder assembly into the cylinder head (observe tightening torque, see brief instructions).

Note:

If the tightening torque is exceeded, this may lead to jamming of the needle valve. Tighten the union nuts of the fuel-injection tubing to 25 Nm.

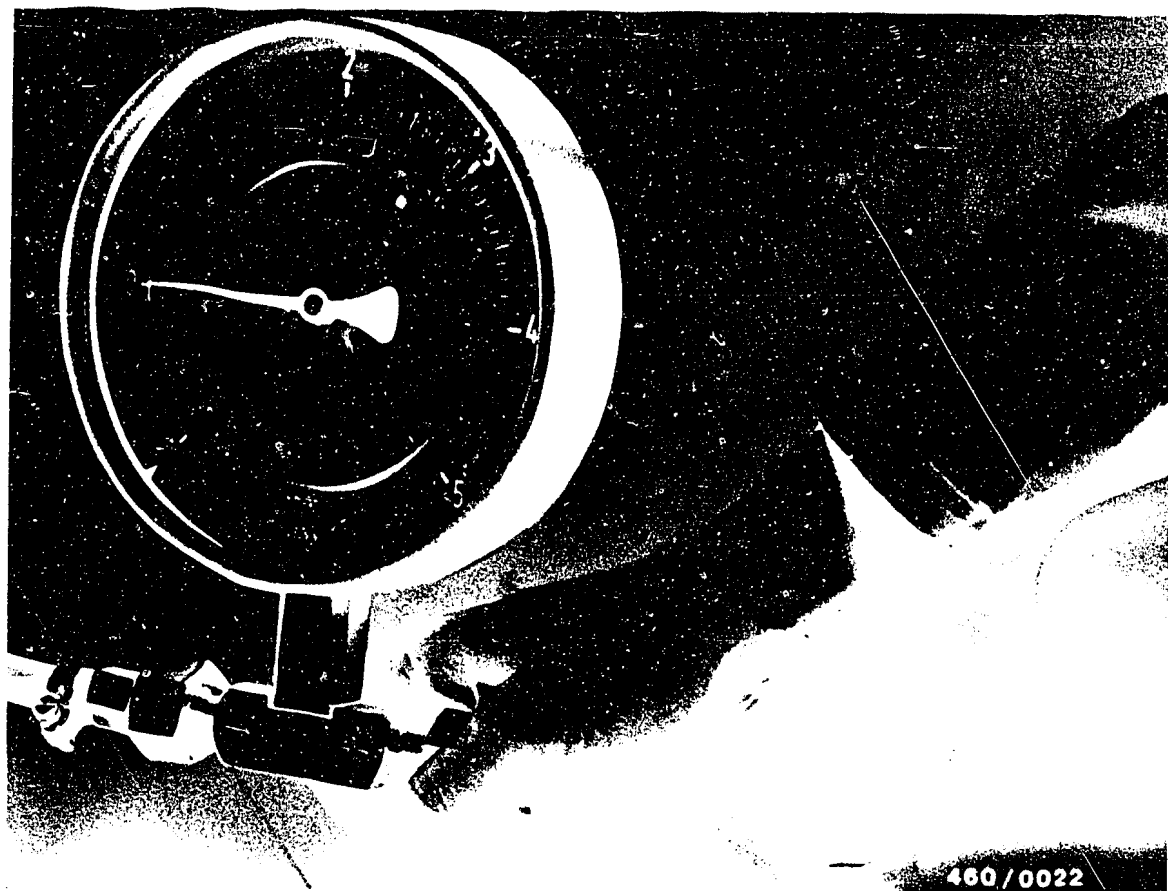
Return to trouble-shooting chart B04



- 1 = Differential-pressure gauge
- 2 = Filter outlet
(use inlet union and extra-long inlet-union screw 2 443 456 020)
- 3 = Filter inlet
(use inlet union and extra-long inlet-union screw 2 443 456 020)

CHECKING THE FUEL FILTER (DIFFERENTIAL-PRESSURE TEST)

Connect the differential-pressure gauge to the fuel filter using appropriate connecting pieces.



Connect the (+) side of the differential-pressure gauge to the fuel filter inlet.

Fit the (-) connection of the pressure gauge to the filter outlet.

See connection diagram.

Run engine until you are sure that there is no air in the fuel system.



Move the accelerator pedal (illustration, arrow) briskly (approx. 1 second) from the idle stop to the maximum-speed stop.

Release the control lever and read off the differential pressure on pressure gauge.

The differential pressure may reach a max. of 0.3 bar.

If this value is exceeded, replace the filter.

Remove test connections.

If necessary, bleed the fuel system.

Return to trouble-shooting chart B04

CHECKING THE TIMING DEVICE/SOLENOID-OPERATED- VALVE START OF INJECTION

Timing device

Prerequisite:

- Activation of solenoid-operated valve O.K.
- Engine cold, $< 30^{\circ} \text{C}$
- Disconnect needle-movement-sensor connection.

Functional test:

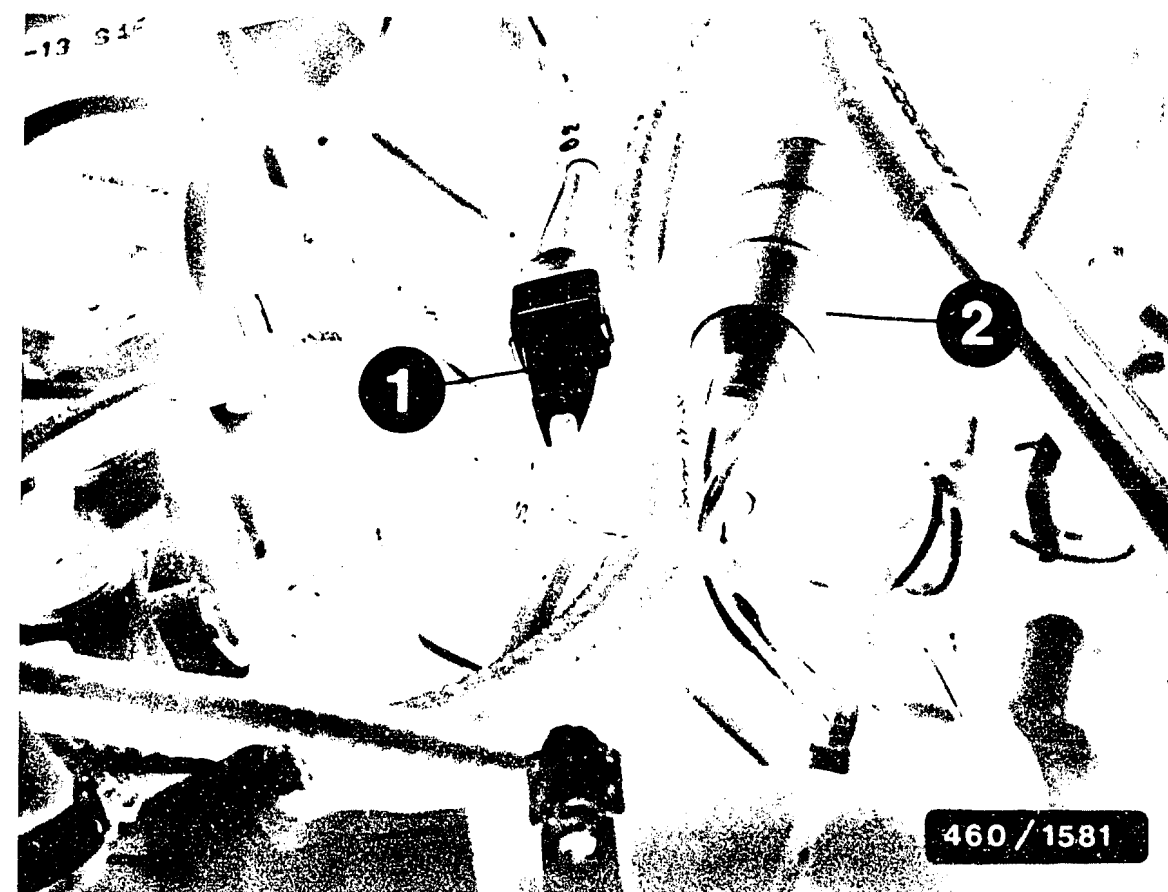
Run engine at idle speed.

Disconnect the multiple butt con. from the sol.-op. vlv.

The engine will run harsher if the ignition timing is advanced.

If the engine does not run harsher, remove the fuel-injection pump (caused e.g. by solenoid-operated valve or timing device being jammed).

Return to trouble-shooting chart B04



MEASURING THE ENGINE COMPRESSION AND COMPRESSION LOSS

Measuring the engine compression.

Fit a new chart in the compression tracer.

Secure the high-pressure hose on to the tracer.

Switch off the engine.

In order to prevent fuel from being injected, disconnect the 7-pin plug connection (2).

Unscrew the sheathed-element glow plugs and use a suitable connecting nipple for the compression tester.

With the aid of the starting motor, turn the engine over several times so that loose deposits are removed from the compression space.

Screw in the connecting nipple.

Mount the high-pressure hose of the compression tester on the connecting nipple.

During the following operation, pay particular attention to the first compression stroke.

Operate the starting motor until there is no longer any detectable pressure rise on the compression tracer.

Bleed compression tracer by pressing on bleeder valve.

The pointer returns to the starting position.

Move the chart into the next position.

Mount the connecting nipple on following cylinders and repeat measurement.

Compression:

For set values, see brief instructions.

Allowable difference between cylinders:

For set values, see brief instructions.

Evaluation of the chart

Normal pressure rise:

If the piston rings and valves are in good condition, the first compression stroke shows the highest pressure increase.

During the following compression strokes, the compression builds up to the maximum pressure.

Gradual pressure rise:

If, from the start, the compression increases only gradually on each piston stroke, this points to burnt valve seats or defective valve guides.

Low maximum pressure:

If the maximum pressure obtained is too low on all cylinders, this points to defective pistons, piston rings or valves.

If the compression is too low on two neighbouring cylinders, this points to a leaky cylinder-head gasket.

Varying compression

If one cylinder shows a clearly lower compression, proceed as follows:

Fill in 2...3 cm³ of engine oil through the opening of the sheathed-element glow plug or nozzle-holder assembly and operate the starting motor briefly.

Repeat measurements and compare the charts.

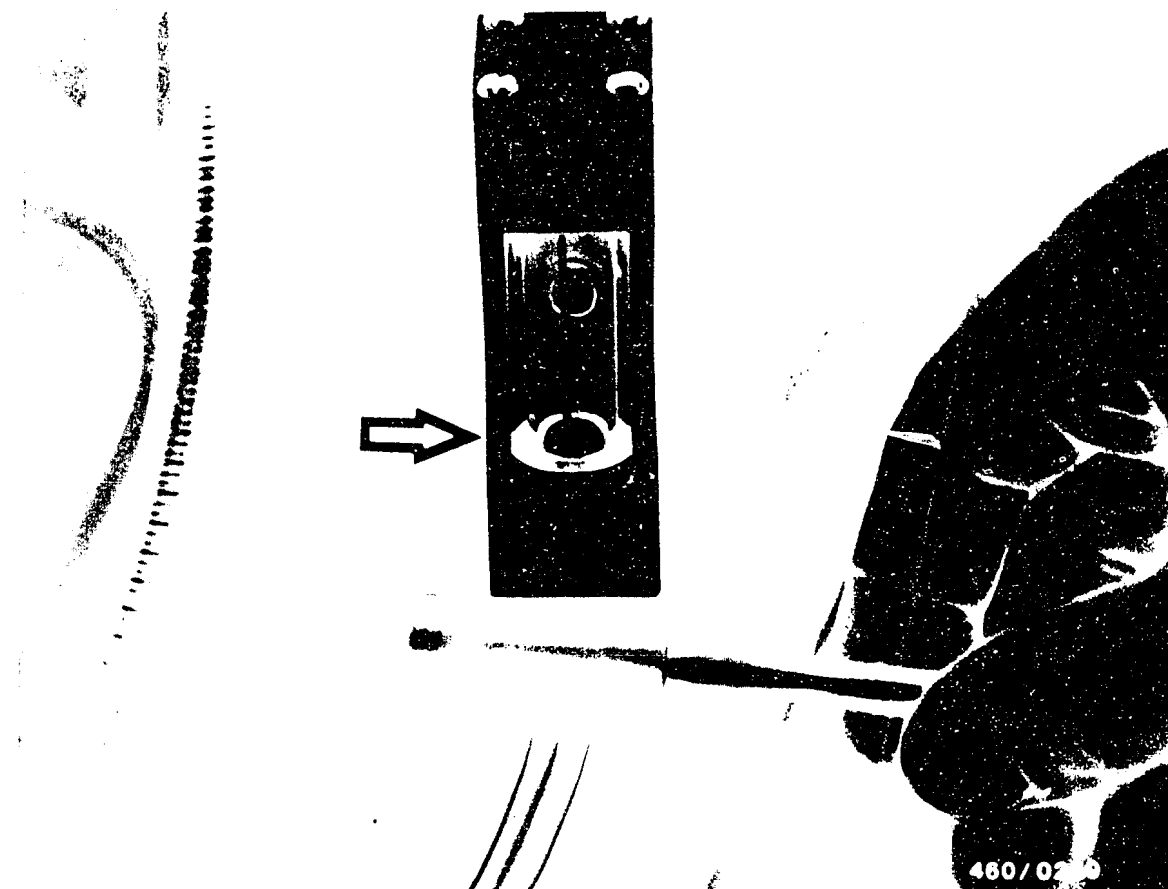
If there is a clear increase in compression during the second test, then the piston rings or cylinders are worn.

If there is no change in the result, then defective valves are the cause.

Uniform compression

Uniform compression is extremely important with regard to the smooth running of the engine.

Maximum compression is, therefore, not the only object.



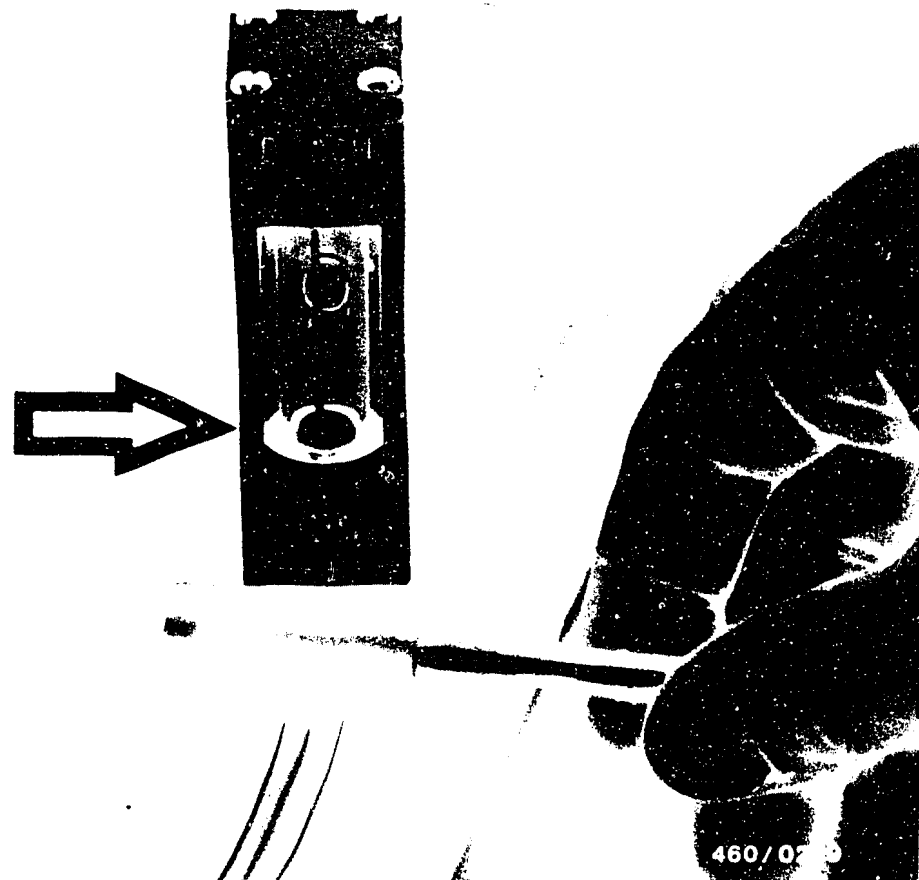
Measuring the compression loss of the engine

The test is performed using the
BOSCH compression-loss tester 0 681 001 901
(EFAW 210 A)

For testing, the respective piston must be at TDC (TDC = top dead center) on the compression stroke.

For setting this position, use the DC detect-
or 1 688 132 025 (included in accessories with
the compression-loss tester).

Perform the test with the engine at normal
operating temperature (water temperature
approx. 80° C).



Setting top dead center

Remove the sheathed-element glow plug from cylinder 1.

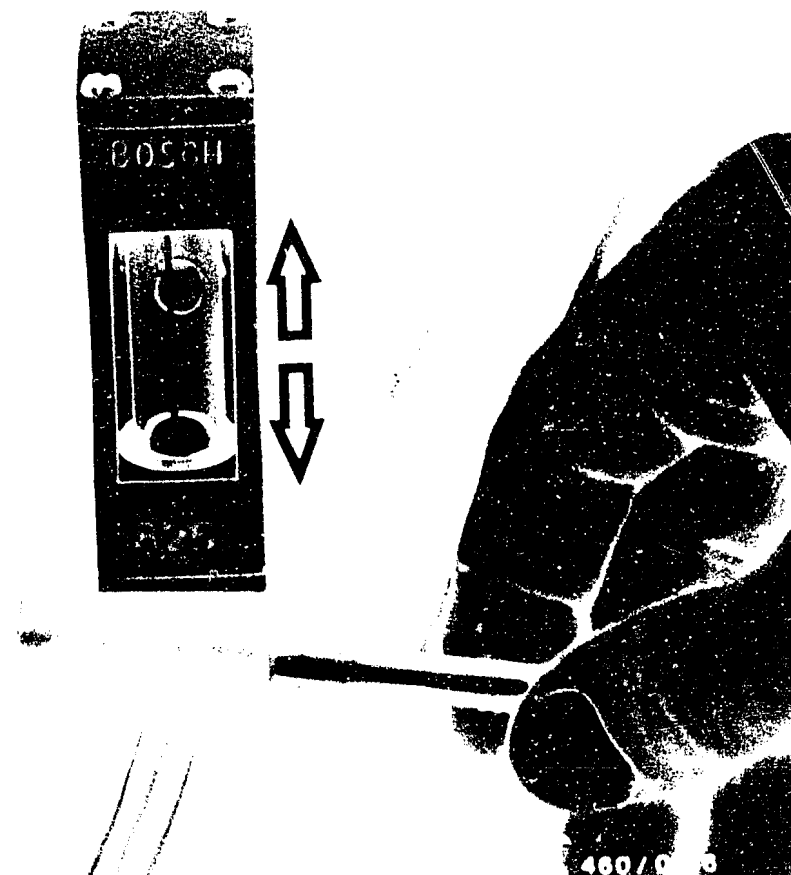
Insert the rubber plug of the DC detector into the bore for the sheathed-element glow plug.

Using a magnetic clamp, mount the glass cylinder in as vertical position as possible in the engine compartment.

The piston of the unit must be easily visible.

Slowly turn the engine over by hand in its direction of rotation.

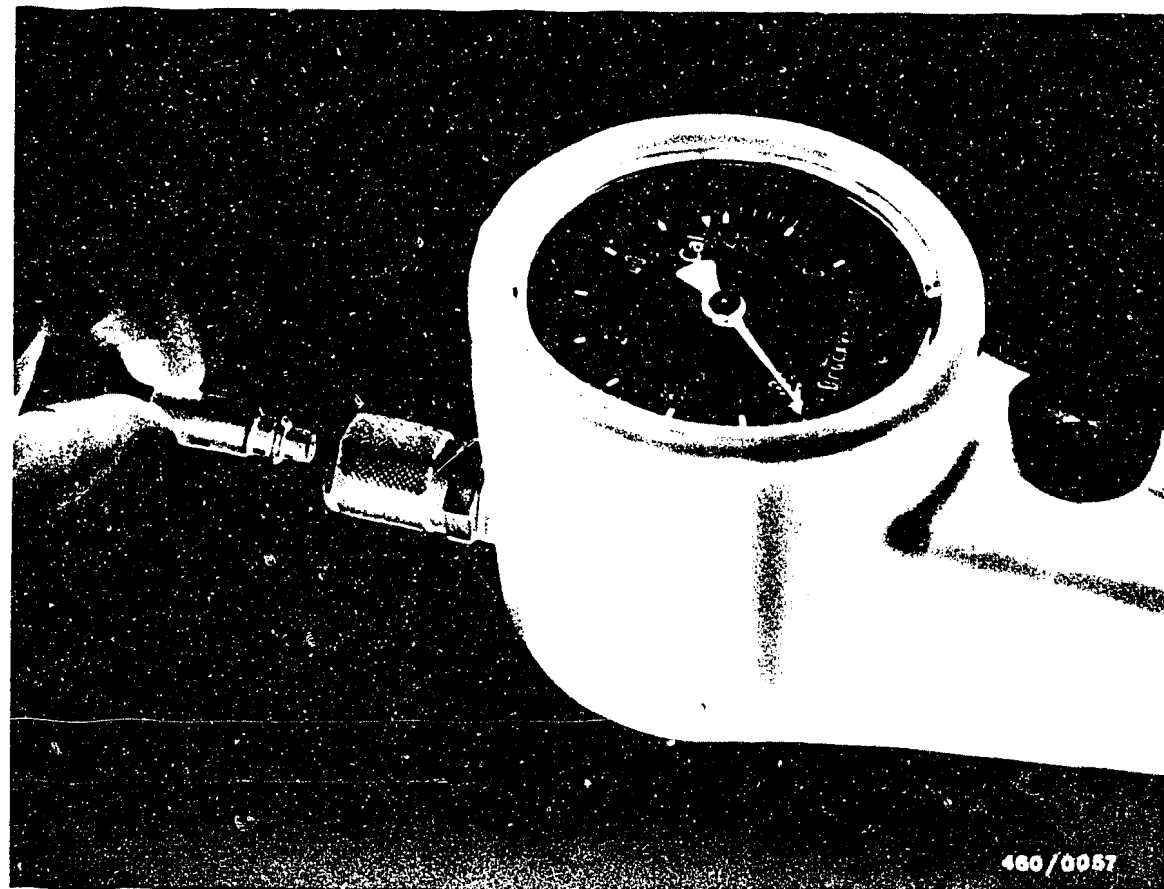
(If necessary, select a gear and push vehicle).



On the compression stroke, the piston of the DC detector is forced upwards.

As top dead center is passed over, the piston slides down again immediately.

Locate top dead center by carefully turning the engine backwards and forwards.



Measure the compression loss

Connect the tester to the compressed-air mains.

Connect the calibrating nozzle 1 680 363 036.

Set a compression loss of $23 \pm 1 \%$ (marking "Cal.") at the knurled thumbscrew on the pressure-regulating valve.

The instrument indicator may deviate from the zero point by plus/minus one scale mark.

If this is not the case, the tester is defective.



Screw in the fitting and mount the test hose.

Select a gear and pull on the handbrake.
Connect the test hose to the tester.
Read off the compression loss in % on the instrument.

Note:

Before testing the next cylinder, turn the engine over briefly without preheating using the starting motor so that the oil film reforms.

Evaluation of the test

The compression loss indicated should not exceed 25%.

Differences of 10 % between the individual cylinders can be ignored.

The causes of greater losses can be located, because the air makes a noise as it escapes.

Listen at the following points:

Location of noise	Possible trouble
Intake manifold (Remove air filter)	Intake valve
Exhaust manifold	Exhaust valve
Oil filler neck on engine	Pistons/piston rings
Cooling water filler neck (air bubbles)	Cylinder-head gasket

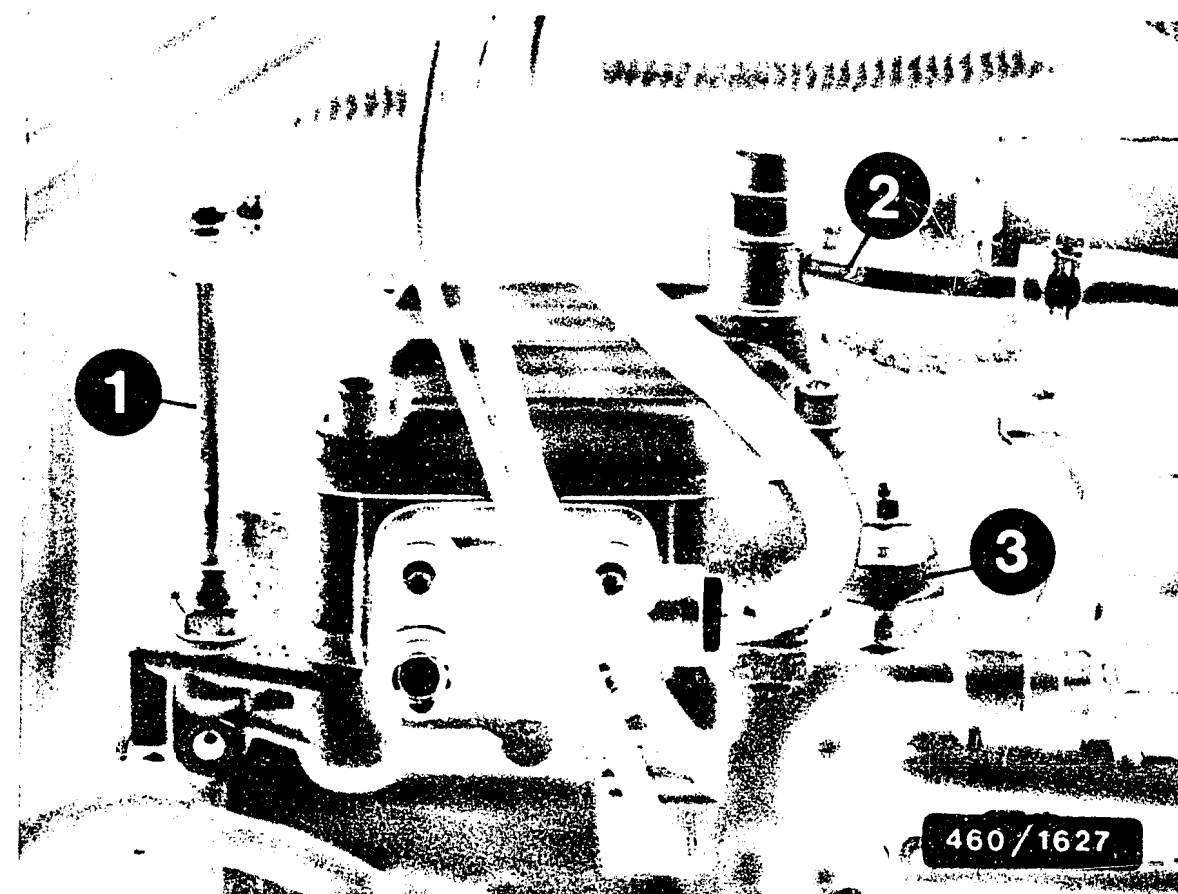
In order to trace the trouble even more accurately, fill approximately 2...3 cm³ of engine oil into the cylinder.

Repeat the test.

If there is a clear decrease in compression loss during this test, then the fault lies with the piston or with the piston rings.

New engines which have not yet been run in (less than 5 000 km) may show higher compression losses than after the running-in period.

Return to trouble-shooting chart B04

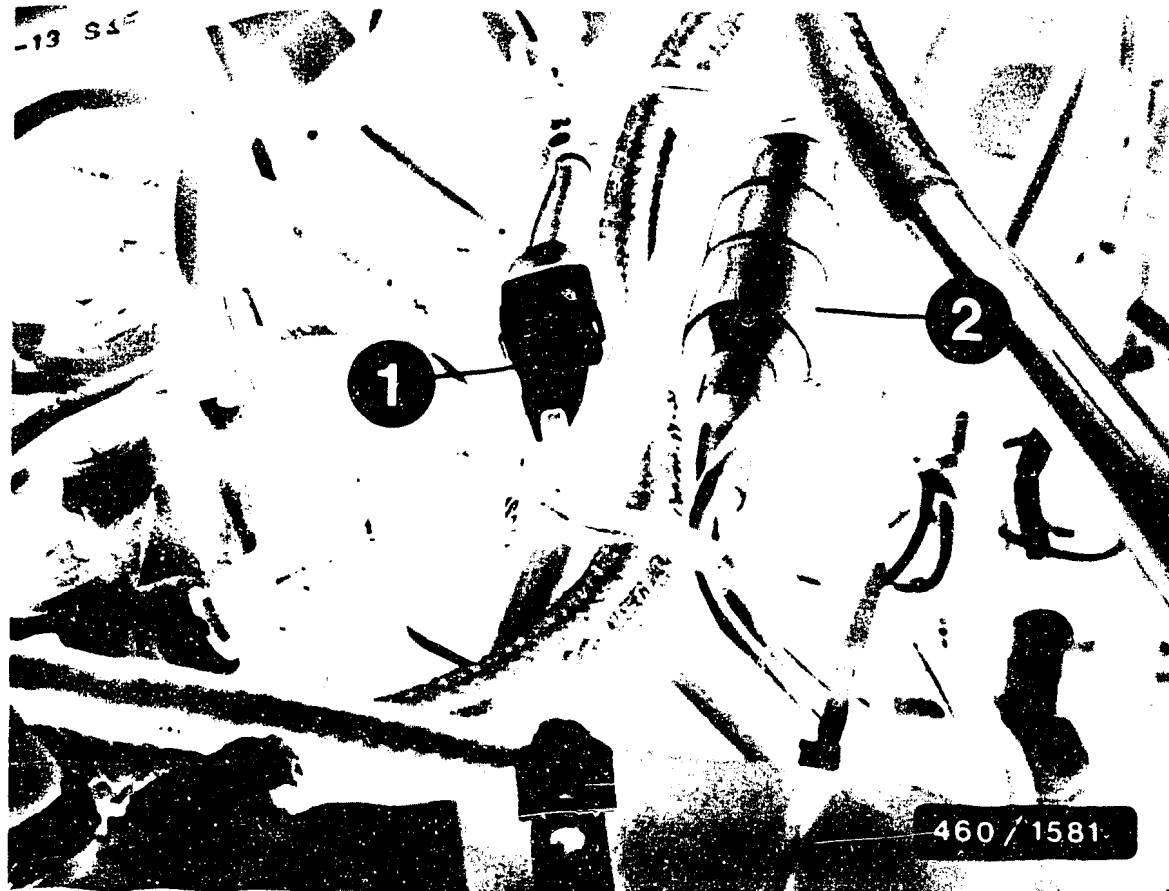


- 1 = Fuel inlet line
- 2 = Fuel return line
- 3 = Emergency shutoff device

REMOVING THE FUEL-INJECTION PUMP

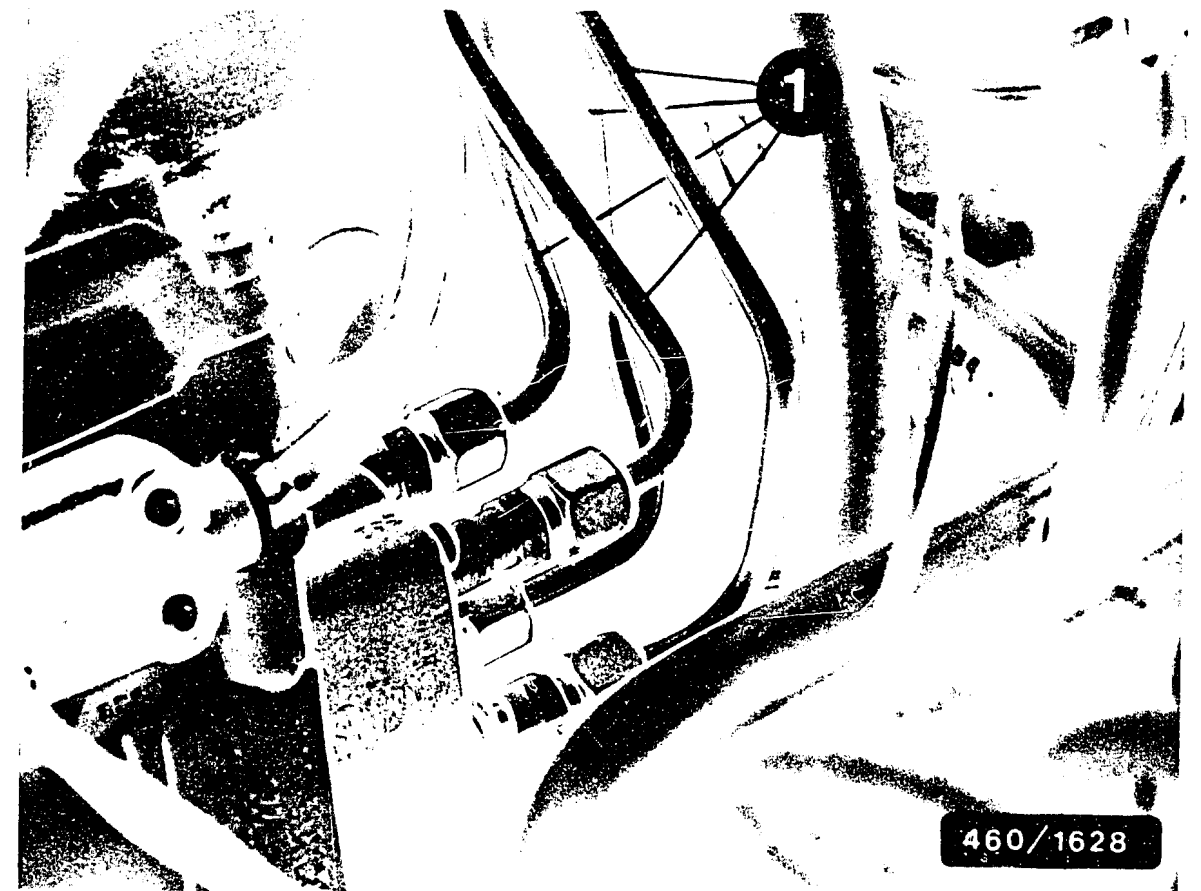
Remove the battery and battery console.

Remove the fuel inlet line (from fuel filter), fuel return line and electric cable from the emergency shutoff device (ELAB).



- 1 = 2-pin plug connection
(solenoid-operated-valve start of injection)
2 = 7-pin plug connection (delivery controller)

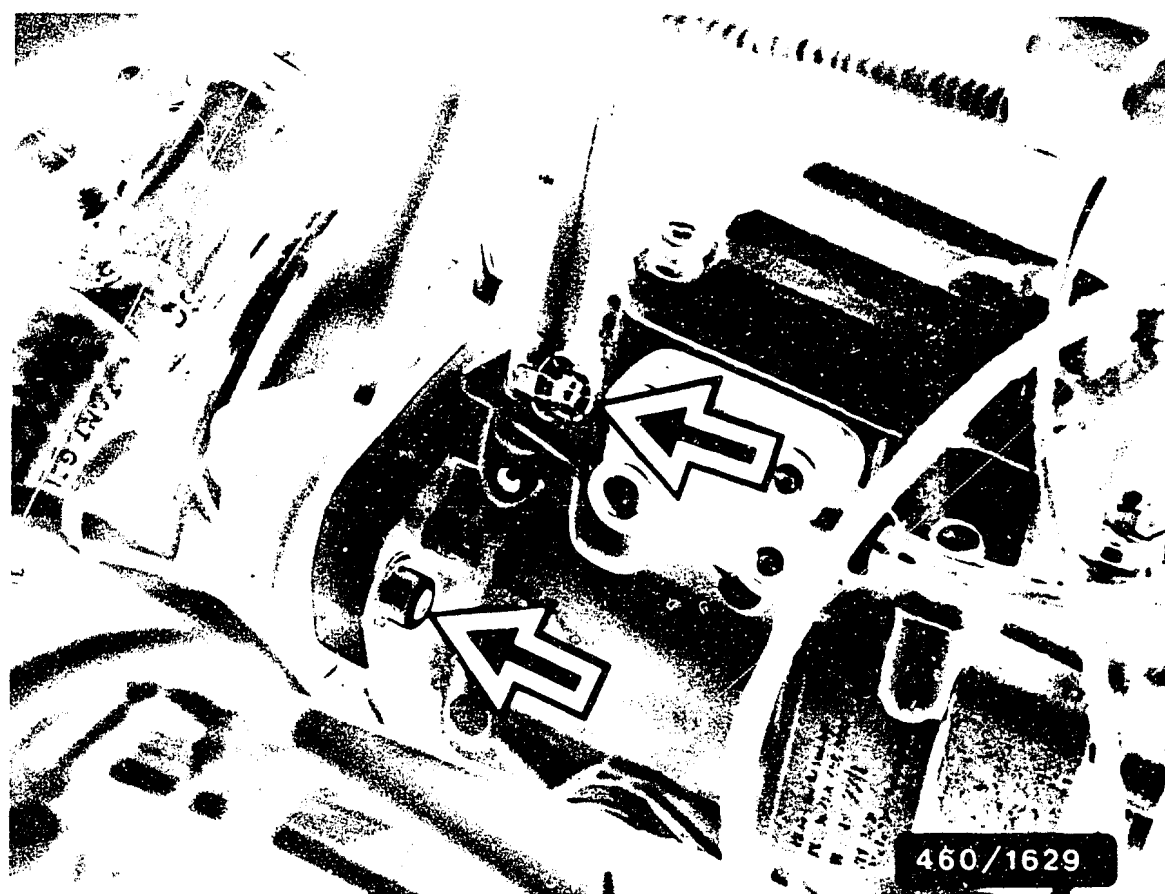
Disconnect both plug connections.



- 1 = Fuel-injection tubing

Loosen the fuel-injection lines using open box wrench KDEP 1115.
(Prevent the delivery-valve holders from coming loose by counterholding with a wrench.)

Remove the support bracket from the hydraulic head.

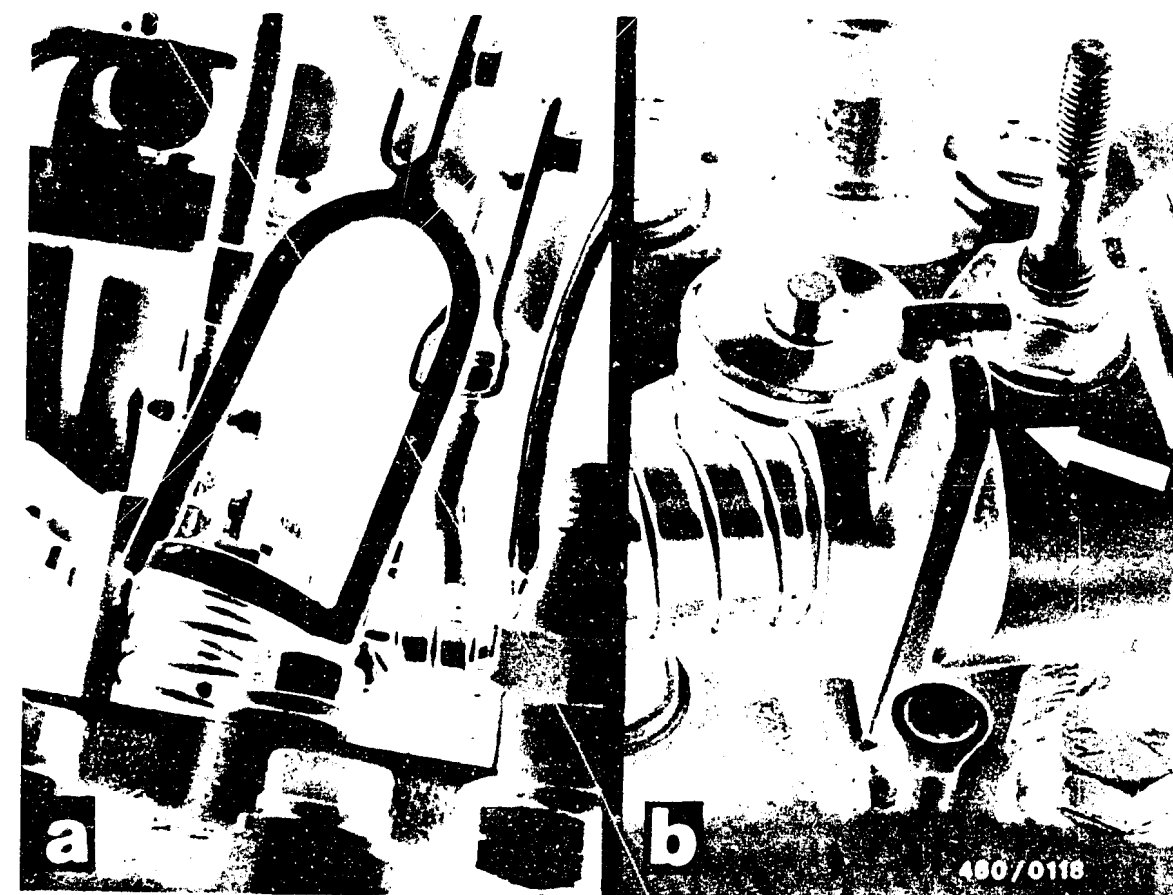


Arrows = Fastening screws

Remove the fastening screws of the fuel-injection pump and remove the pump from the engine.

Note:

Rear fastening screw not visible in the illustration.



INSTALLING THE FUEL-INJECTION PUMP

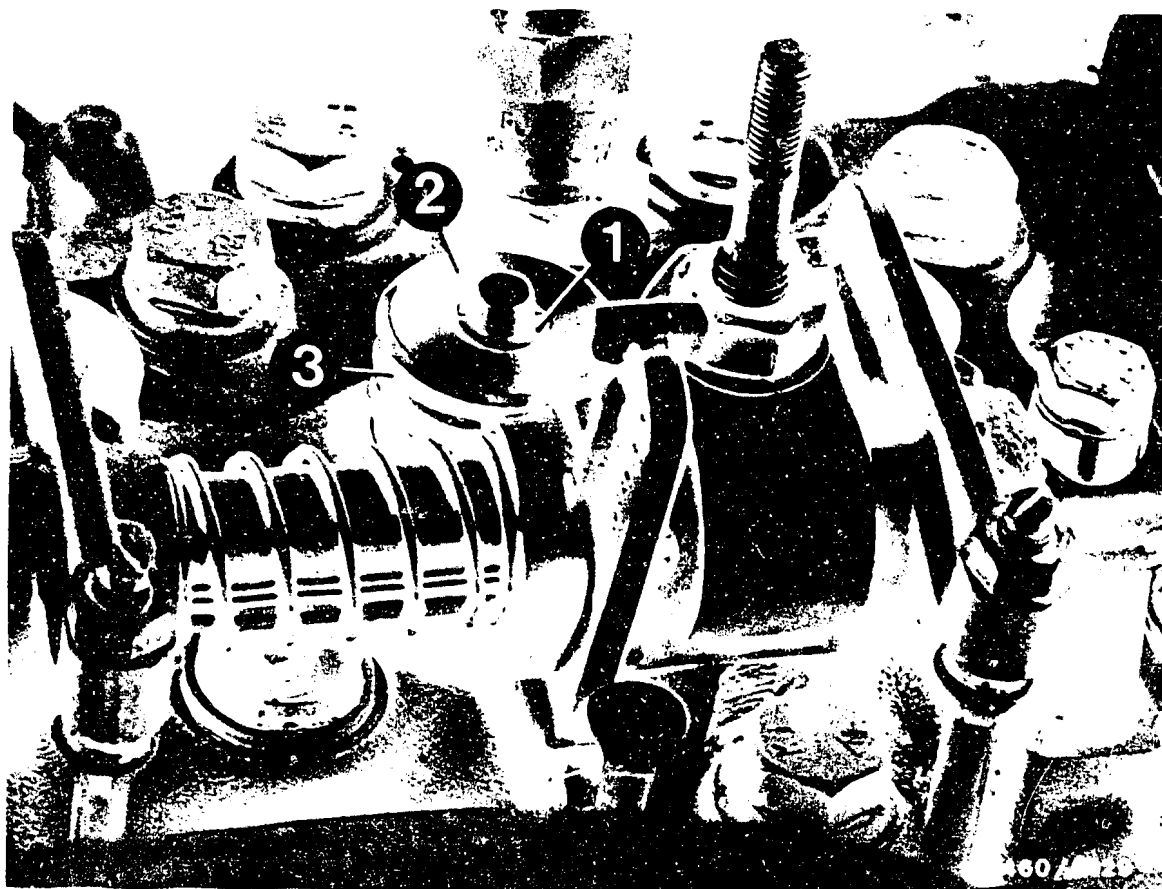
Remove the cylinder-head cover.

Using a box wrench, turn the crankshaft so that the exhaust valve just opens with cylinder 1 in BDC position.

Hook tool 976036 (kit KDEP-T 1200) into the rocker armshaft and force the exhaust-valve spring on cylinder 4 downward (see illustration a).

Move rocker arm against compression spring on rocker arm shaft and place vertically.

In this position, bring the rocker arm into the starting position (see illustration b).



- 1 = Collets
- 2 = Spring seat
- 3 = Valve spring

Turn the crankshaft in the direction of engine rotation until cylinder 4 is at TDC.

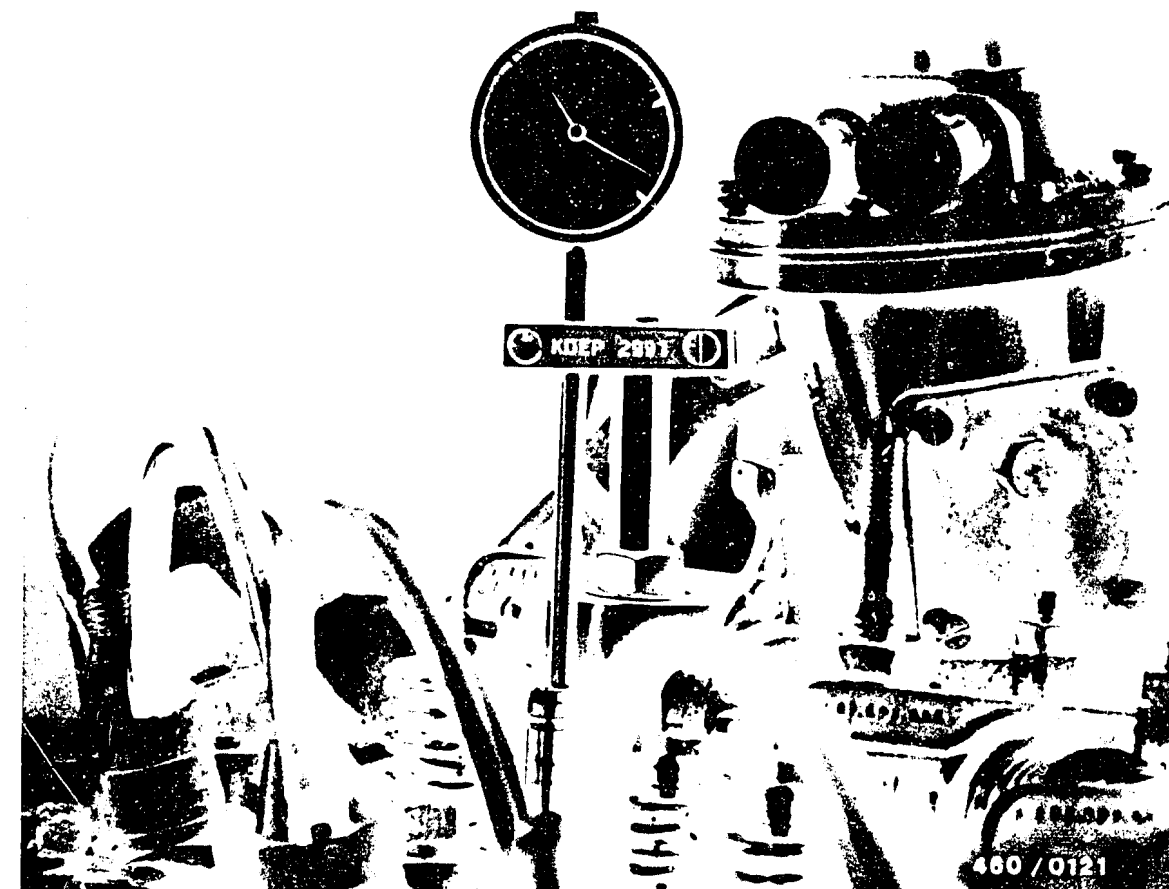
The valves of cylinder 1 are on overlap.

Push the exhaust-valve spring of cylinder 4 downward using tool 976036.

Remove the collets from the exhaust valve.

Relax the valve spring, and remove the spring plate and valve spring from the valve.

The exhaust valve of cylinder 4 is now resting on the engine piston.



Screw the measuring tool KDEP 2991 onto the threaded pin of cylinder 4.

Clamp dial indicator 1 687 233 012 with long measuring base into the measuring tool KDEP 2991.

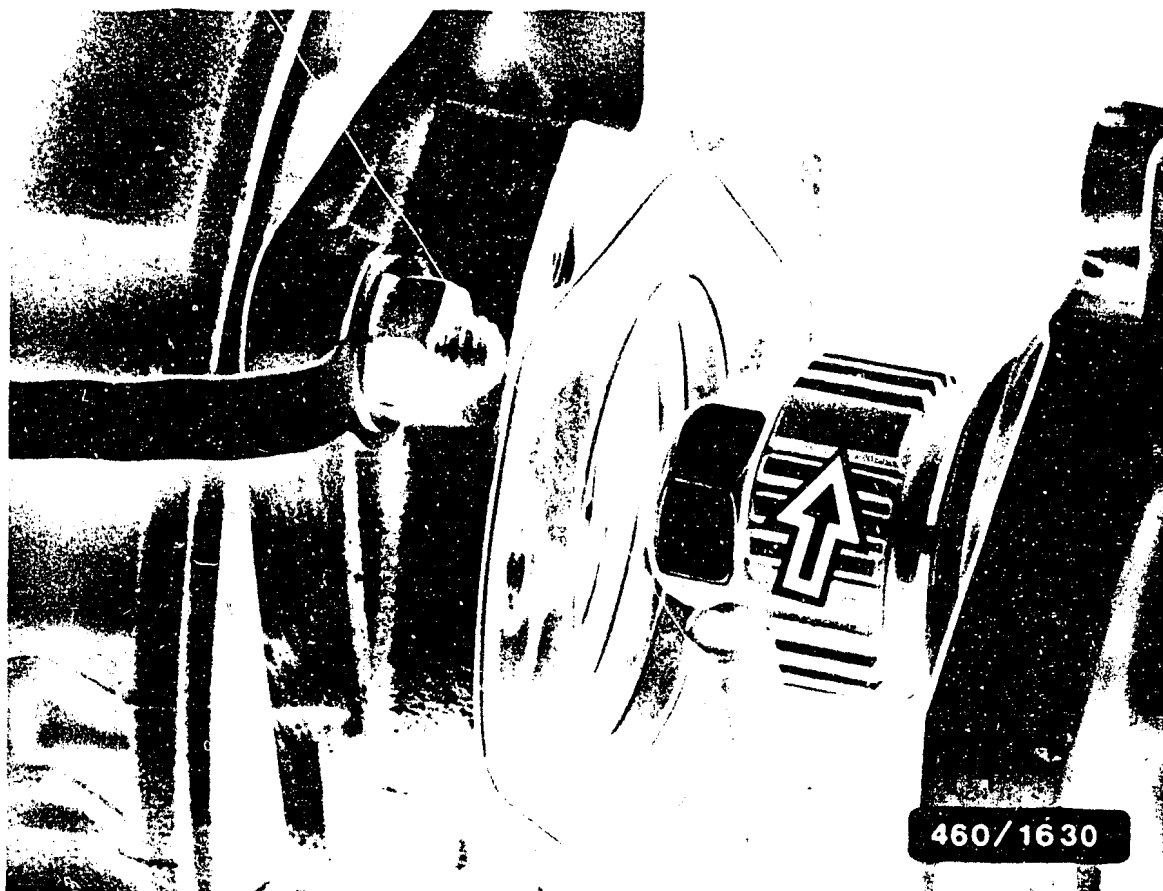
The measuring base rests on the exhaust valve of cylinder 4.

Preload the dial indicator by approx. 10 mm.

Turn the crankshaft against the direction of engine rotation until the piston has covered a stroke of approx. 7 mm.

Turn the crankshaft back in the direction of engine rotation until cylinder 4 is at TDC.

Set the dial indicator to "0".



Turn the injection-pump drive shaft so that the mark on the drive pinion points approximately toward outlet "B" (see illustration, arrow).

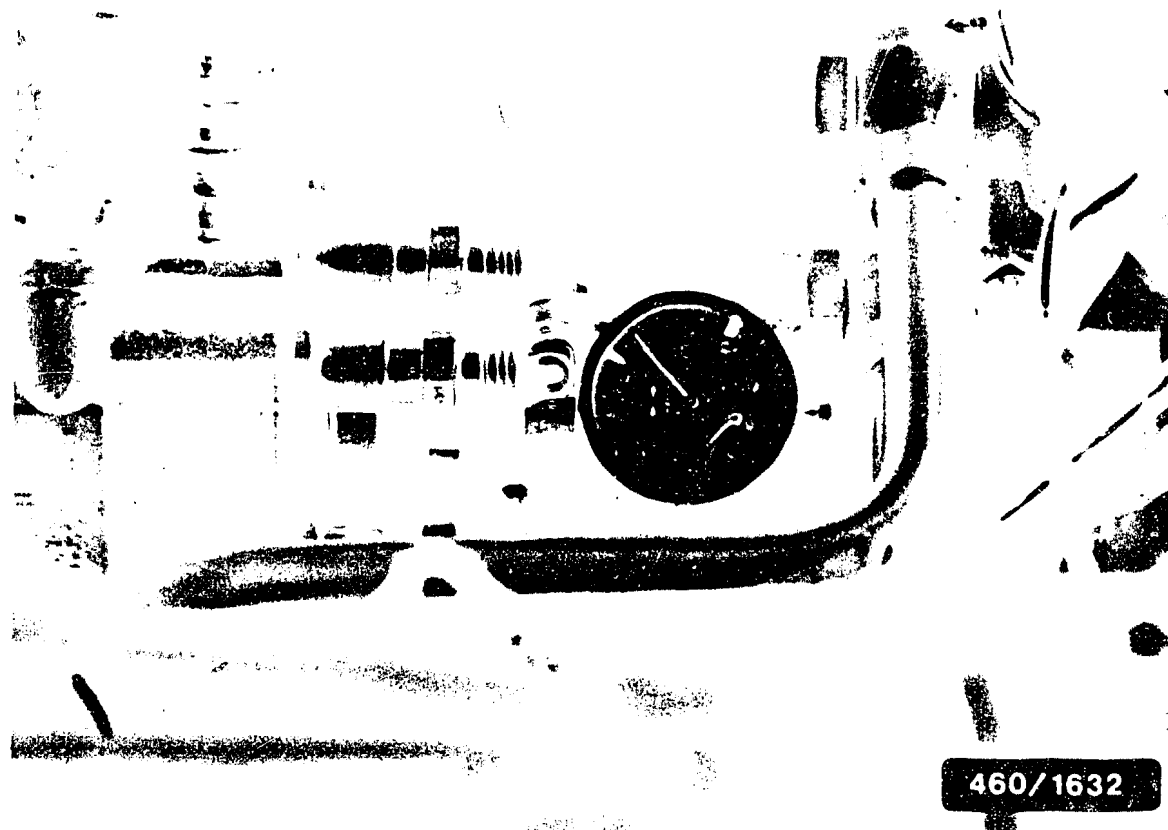
Introduce the injection pump into the engine plug-in sleeve.

Provisionally tighten the fastening screws of the injection pump.



Note on installation:

If the dial indicator 1 687 233 011 or .. 012 is used for setting (injection pump - engine timing), remove the tube from the oil filter (illustration, arrow).



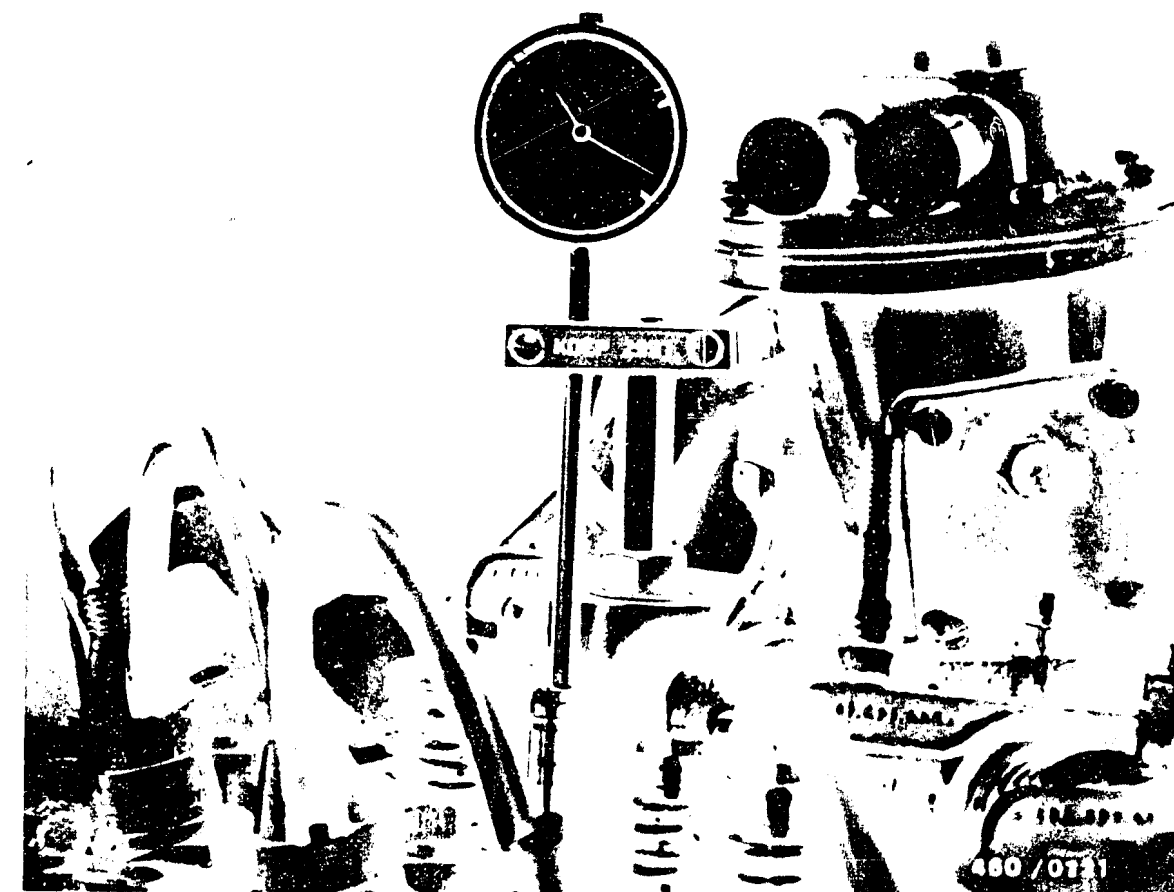
Remove the bleeder screw from the central screw plug (triangular-head bolt) of the injection pump.

Screw measuring tool KDEP 1085 into the bore for the bleeder screw.

Mount the mini dial indicator (see illustration) with measuring base and preload by 3 mm.

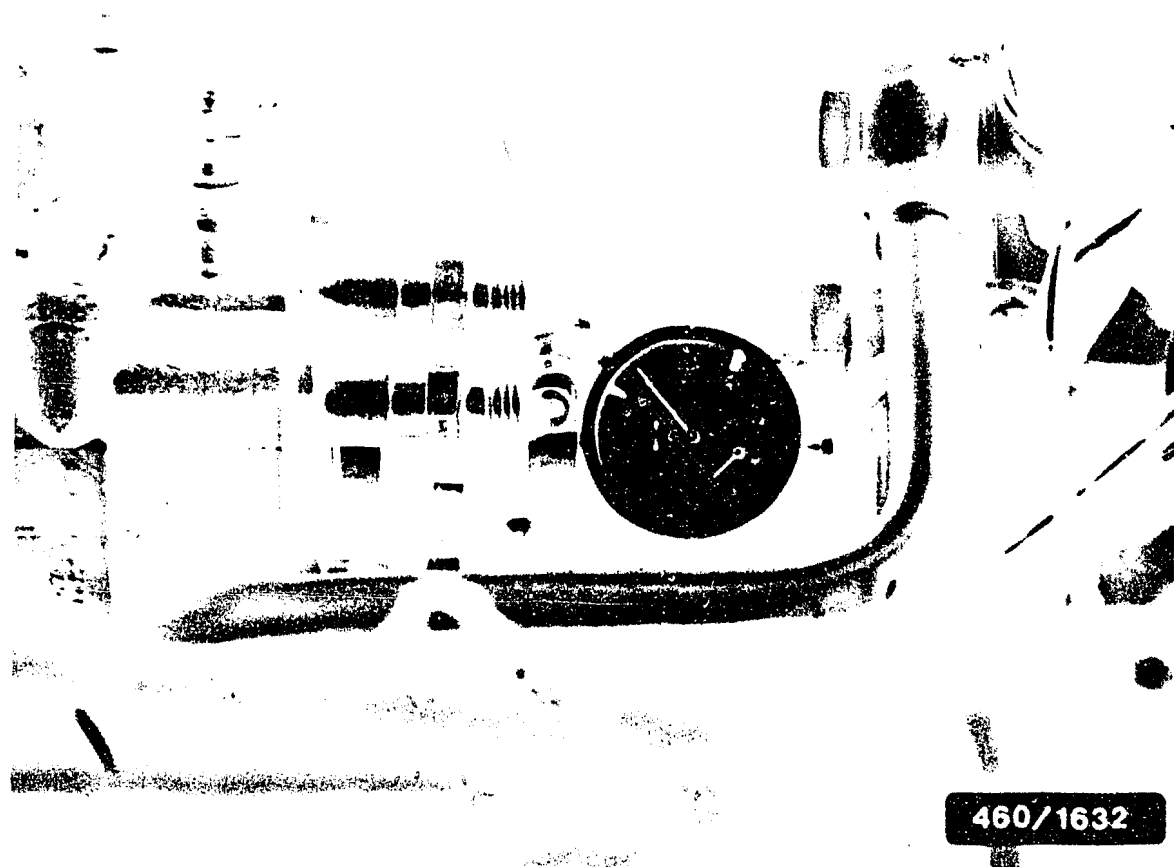
Turn the crankshaft against the direction of engine rotation until the dial indicator indicates BDC position of the injection-pump plunger.

Set the dial indicator to "0".



Turn the crankshaft in the direction of engine rotation until the dial indicator on the exhaust valve of cylinder 4 indicates the appropriate piston stroke (in mm) before TDC for the engine type.

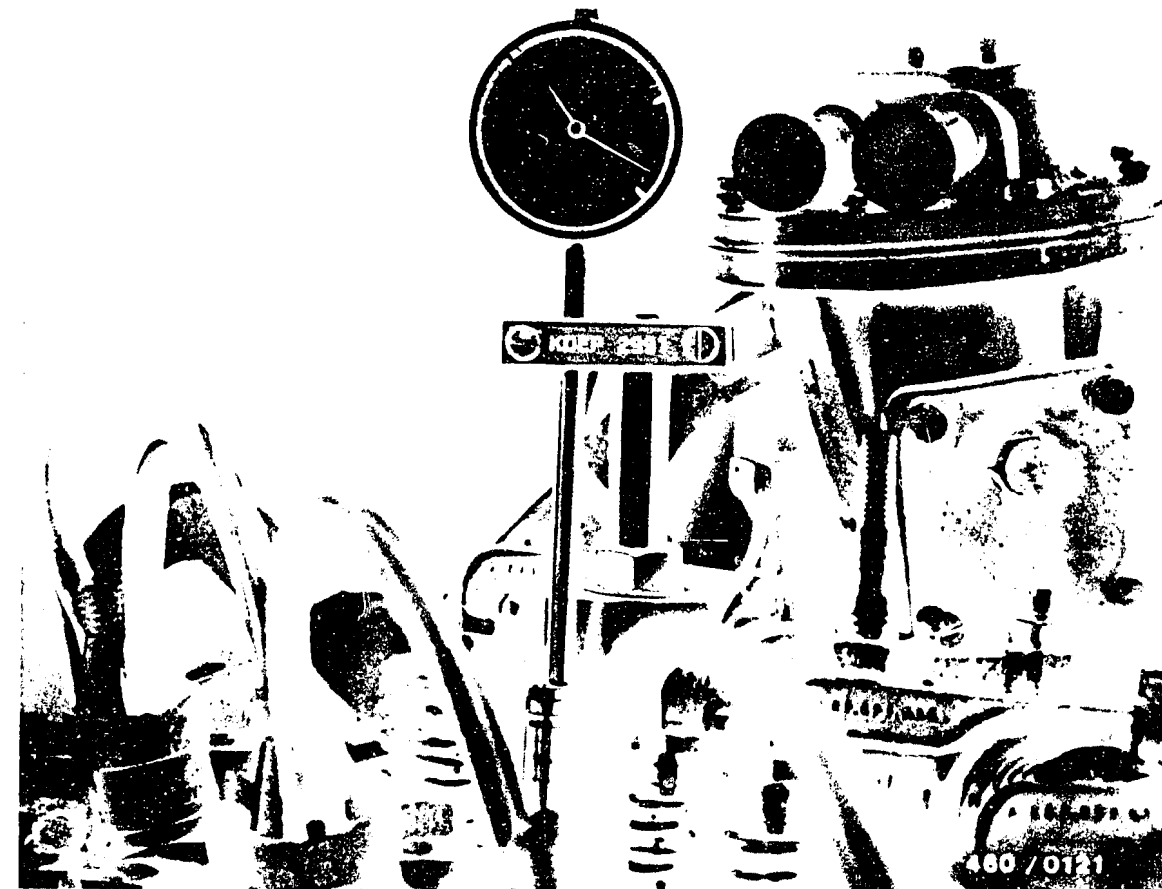
For set value: see brief instructions.



In this engine-piston position, the dial indicator on the injection pump must indicate a stroke in mm (for set value see brief instructions).

If necessary, set the pump-piston stroke by pivoting the injection pump.
(Loosen the fastening screws of the injection pump at the supporting bracket as well.)

Following this, tighten the fastening screws to 20 Nm.

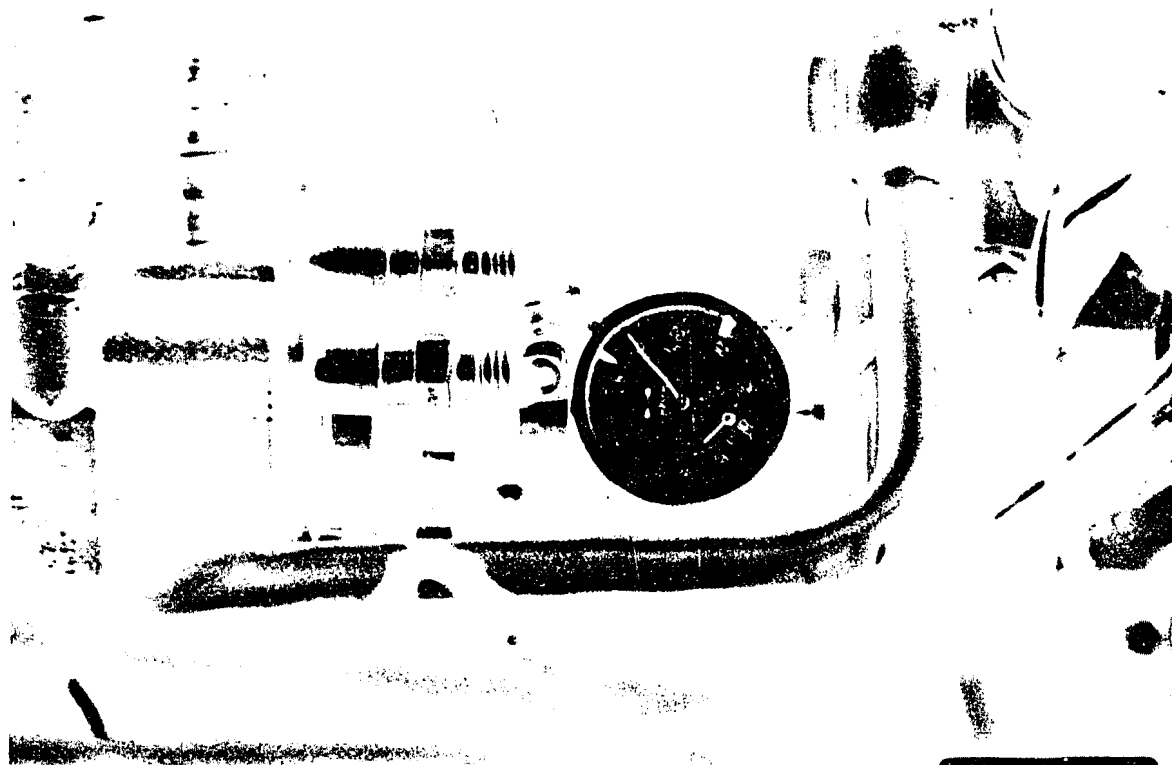


Check the adjustment of the injection pump to the engine (injection timing)

Turn the crankshaft in the direction of engine rotation until cylinder 4 is at TDC.

Check the 0-position of the dial indicator on the exhaust valve.

Turn the crankshaft against the direction of engine rotation until the dial indicator indicates a stroke of approx. 7 mm.



460/1632

Turn the crankshaft in the direction of engine rotation until the dial indicator on the injection pump indicates a stroke in mm (for set value, see brief instructions).

In this position, the piston of cylinder 4 must be at a set value before TDC (see brief instructions).

Remove the measuring tool KDEP 1085 with dial indicator from the injection pump.

Re-mount the bleeder screw with new copper seal ring.

Tighten the injection-pump fastening screws to 20 Nm.

Bring the piston of cylinder 4 into TDC position.

Remove measuring tool KDEP 2991 with dial indicator.

Mount the valve spring and upper spring plate on the exhaust valve of cylinder 4.

Force the valve spring downward using tool 976036.

Install the exhaust-valve collets.
Relieve the tension on the valve spring.

Turn the crankshaft so that the exhaust valve of cylinder 1 just opens with the piston in BDC position.

Force the valve spring of the exhaust valve on cylinder 4 downward with spring plate.

Move the rocker arm against the spring of the rocker arm shaft and position horizontally.

In this position, guide the rocker arm onto the exhaust valve and tappet.

Remove tool 976036.

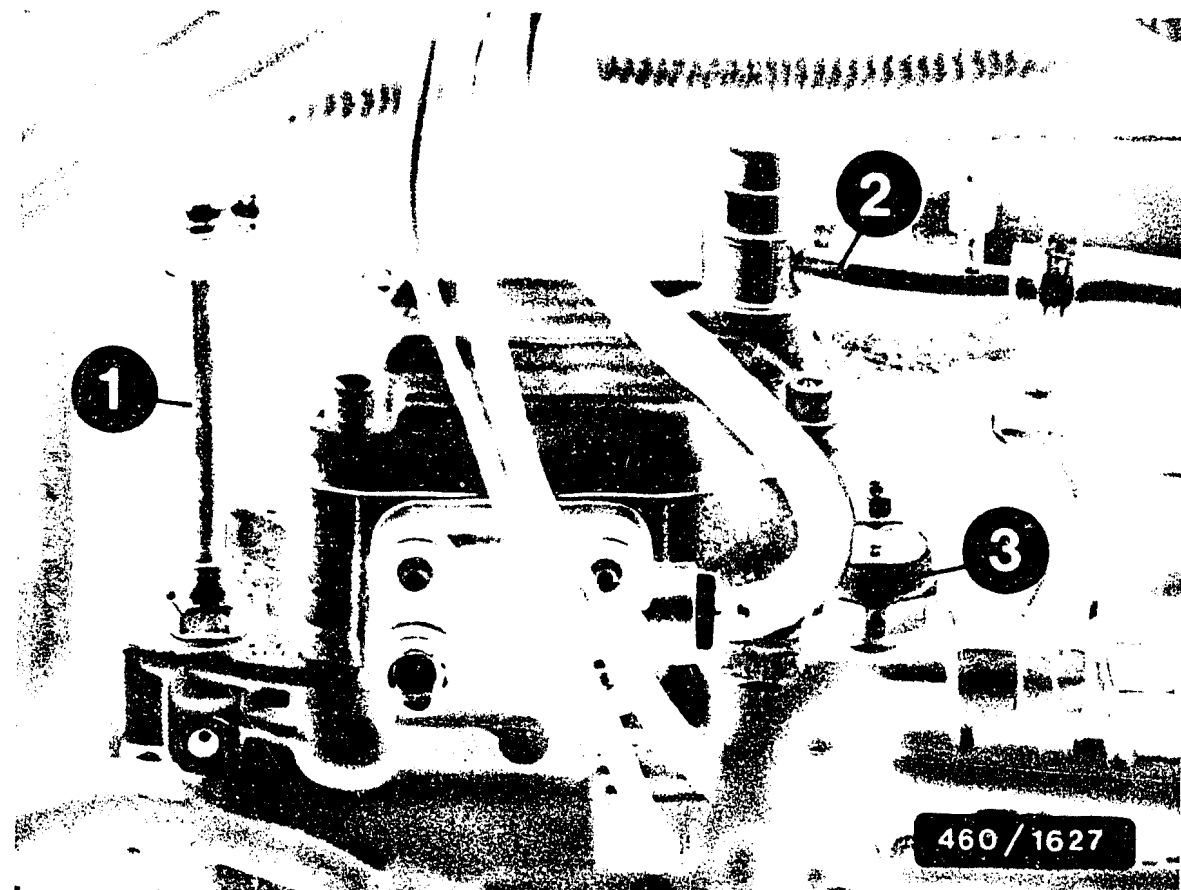
Test the valve clearance:

Test/adjust the valve clearance only when the engine is cold (approx. + 20° C):

Inlet valve: 0.15...0.20 mm

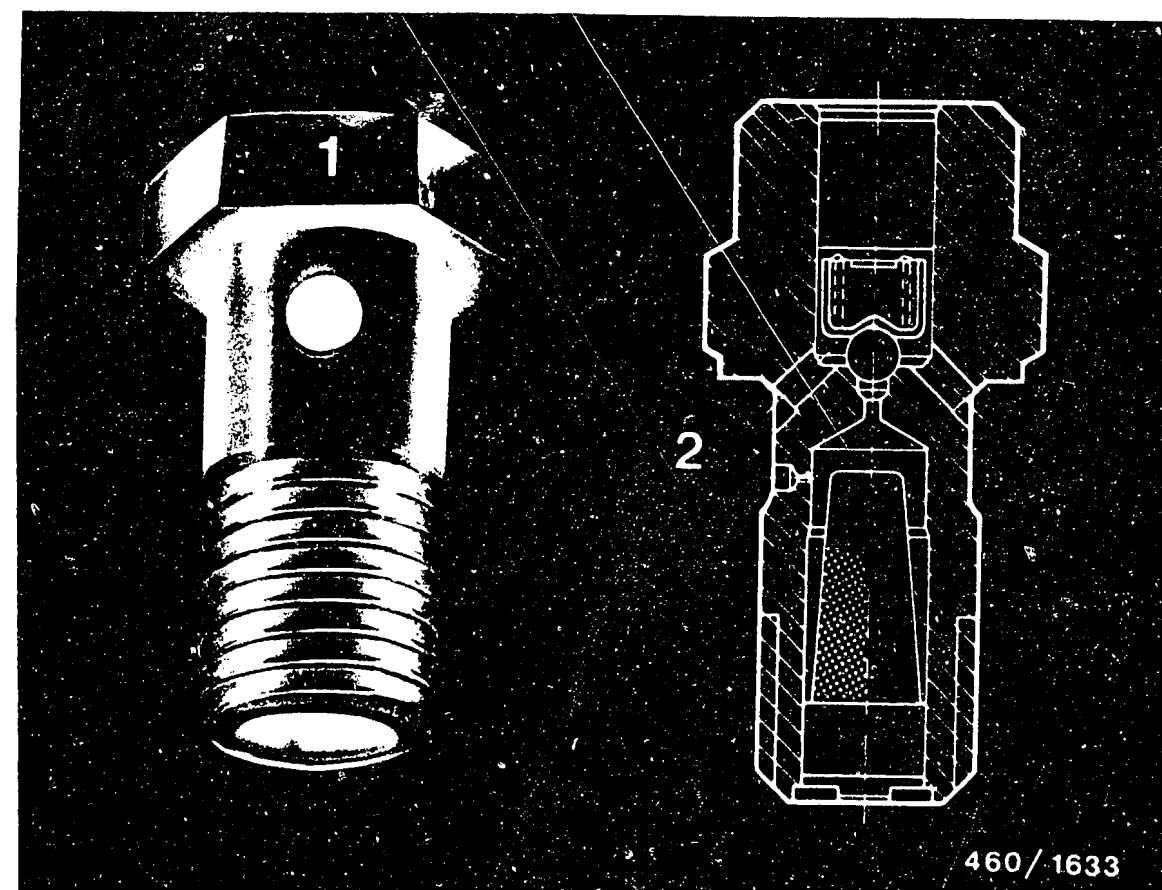
Exhaust valve: 0.25...0.30 mm

Mount the cylinder-head cover.



- 1 = Fuel inlet line
- 2 = Fuel return line
- 3 = Emergency shutoff device

Mount the fuel inlet line, fuel return line and electric cable onto the emergency shutoff device (ELAB).

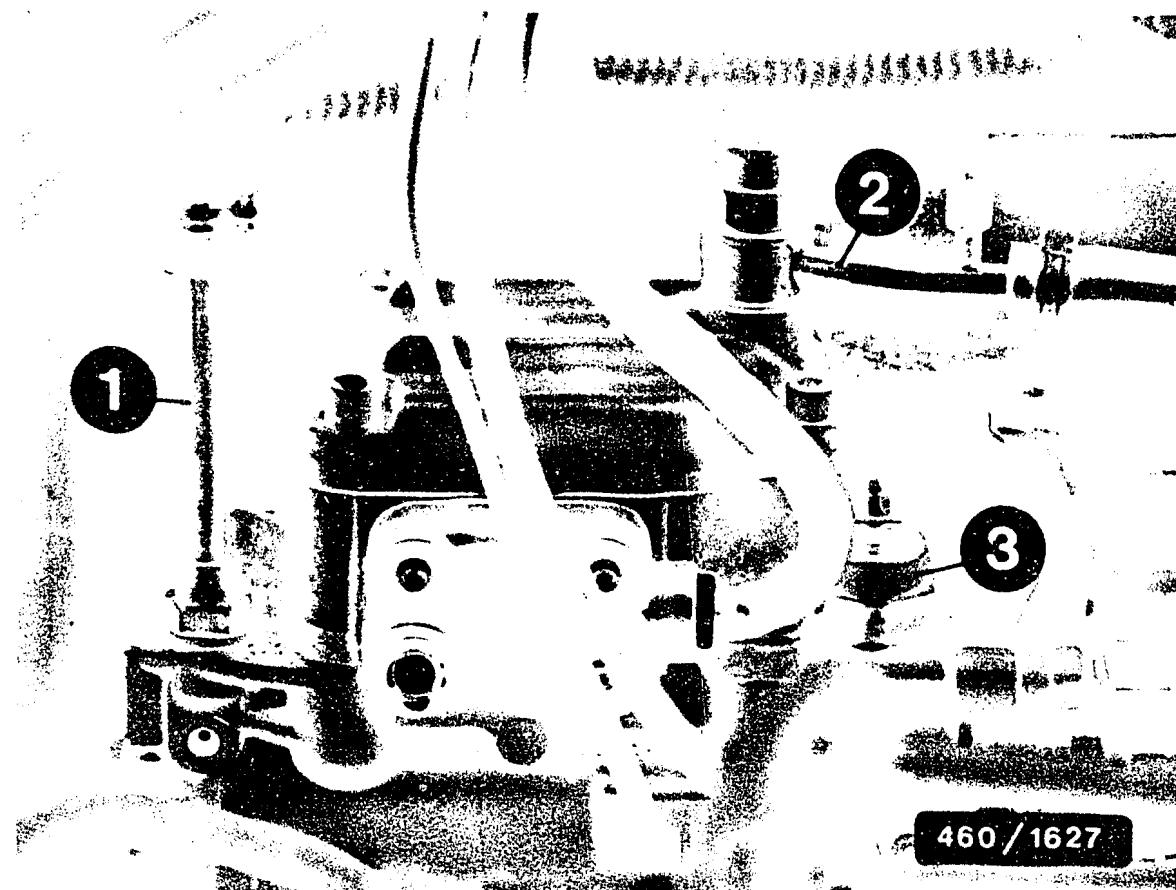


- 1 = Inlet-union screw
- 2 = Inlet-union screw with overflow valve

Note:

The inlet-union screws of the fuel inlet and return lines must not be mixed up.

In the fuel return line, use the inlet-union screw with overflow valve (see illustration).

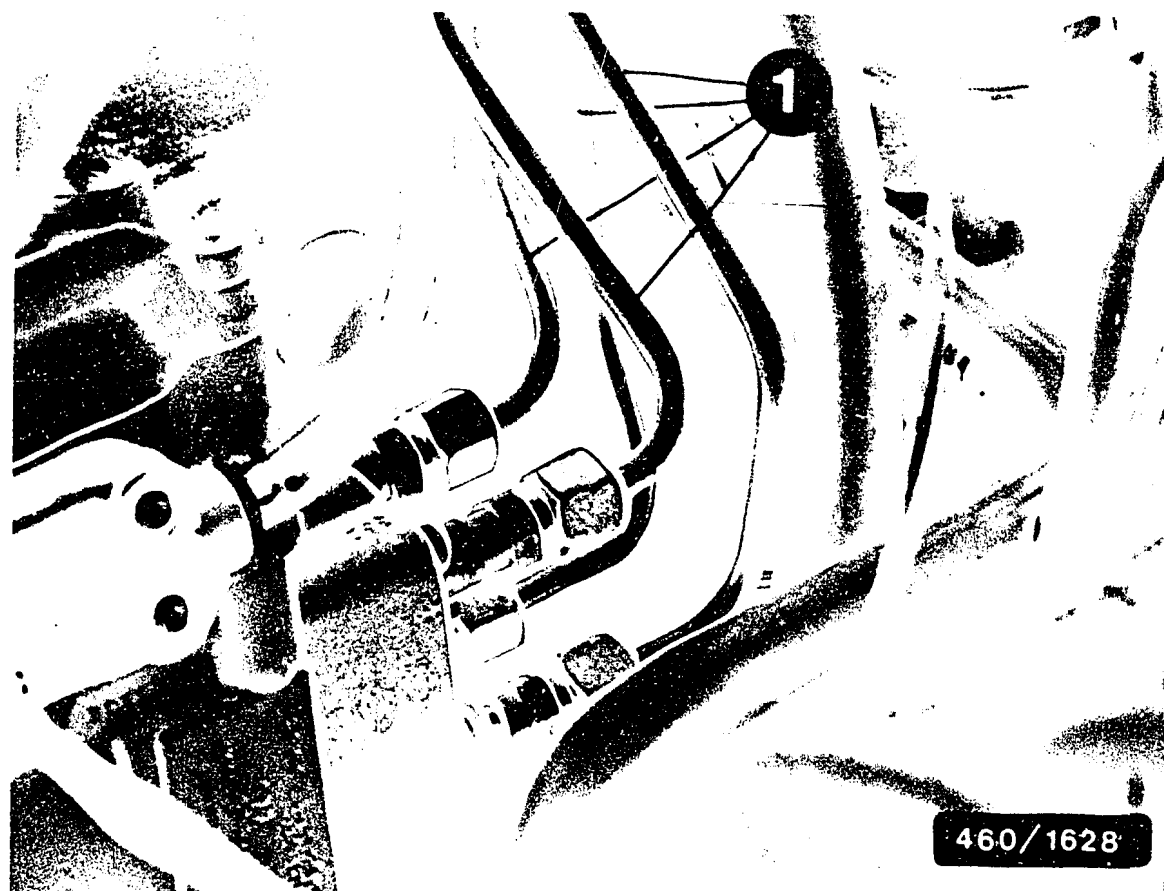


- 1 = 2-pin plug connection
 (solenoid-operated-valve start of injection)
 2 = 7-pin plug connection (delivery controller)

Connect the two connecting plugs together.



If the dial indicator 1 687 233 011 or .. 012 was used for adjusting (injection pump - engine timing), re-mount the lower tube onto the oil filter (illustration, arrow).



1 = Fuel-injection lines

Tighten the injection lines using open box wrench KDEP 1115.

(Prevent the delivery-valve holders from turning by counterholding with a wrench.)

Align the support bracket on the hydraulic head of the injection pump so that it is up against the cylinder block and hydraulic head free of tension.

Screw down the support bracket.

Screw down the battery console, install the battery and connect up.



1 = Bleeder screw

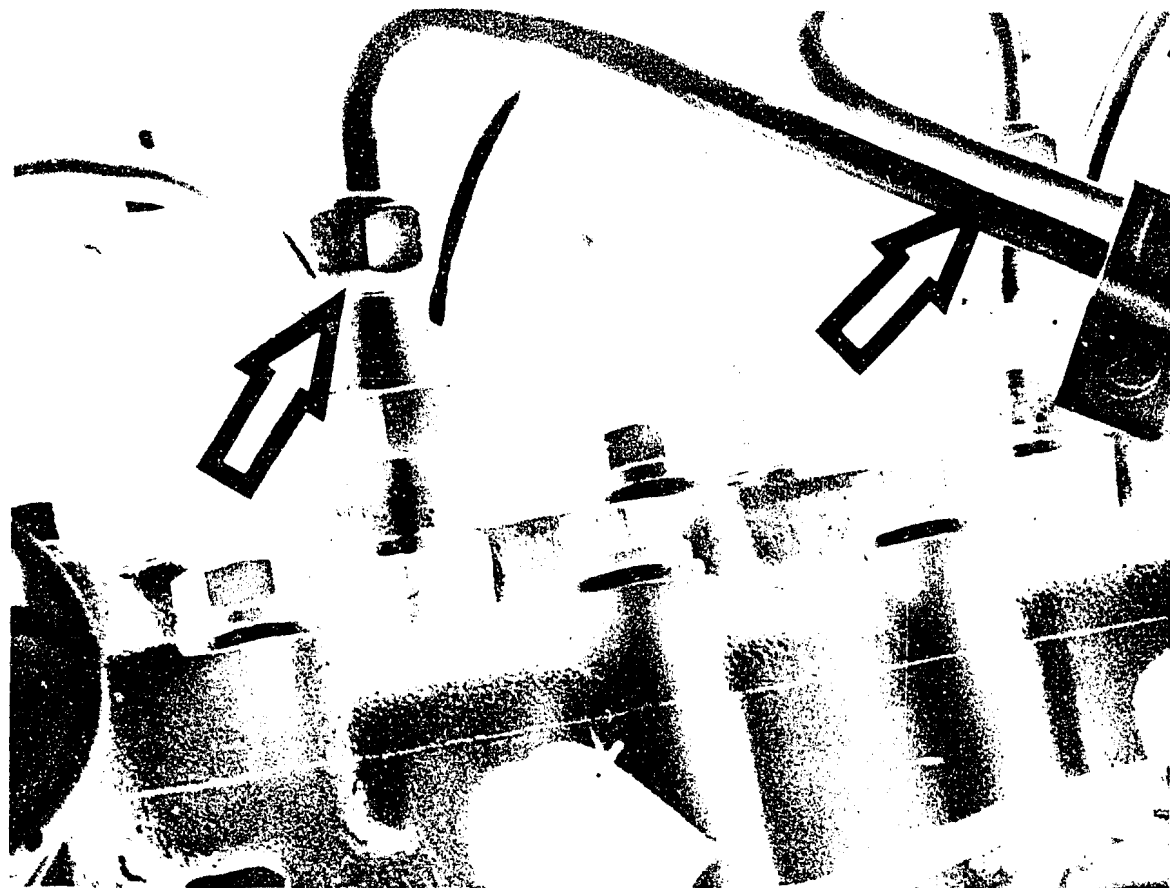
2 = Hand pump

Bleed the fuel system

Loosen the bleeder screw and actuate the hand pump until bubble-free fuel escapes from the bleeder screw.

Tighten the bleeder screw again.

Continue to actuate the hand pump until resistance is noticeable.



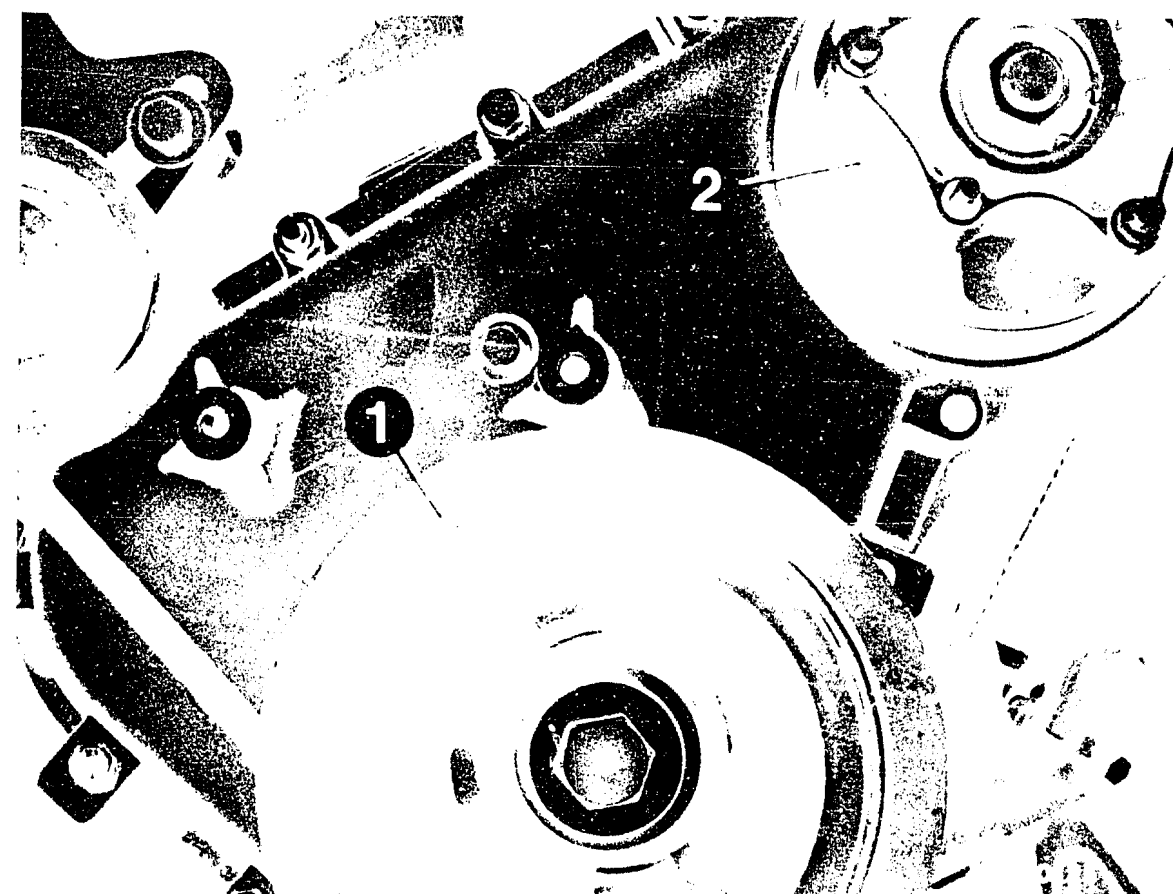
Loosen the union nuts of the fuel-injection tubing at the nozzle-holder assemblies (illustration, arrows).

Operate the starting motor without preheating until fuel escapes from the union nuts of the nozzle-holder assemblies.

Tighten the union nuts.

Operate the starting motor until the engine starts.

Return to trouble-shooting chart B04



1 = Crankshaft pulley

2 = Fan wheel

TESTING AND ADJUSTING THE ENGINE TIMING

Test the engine timing

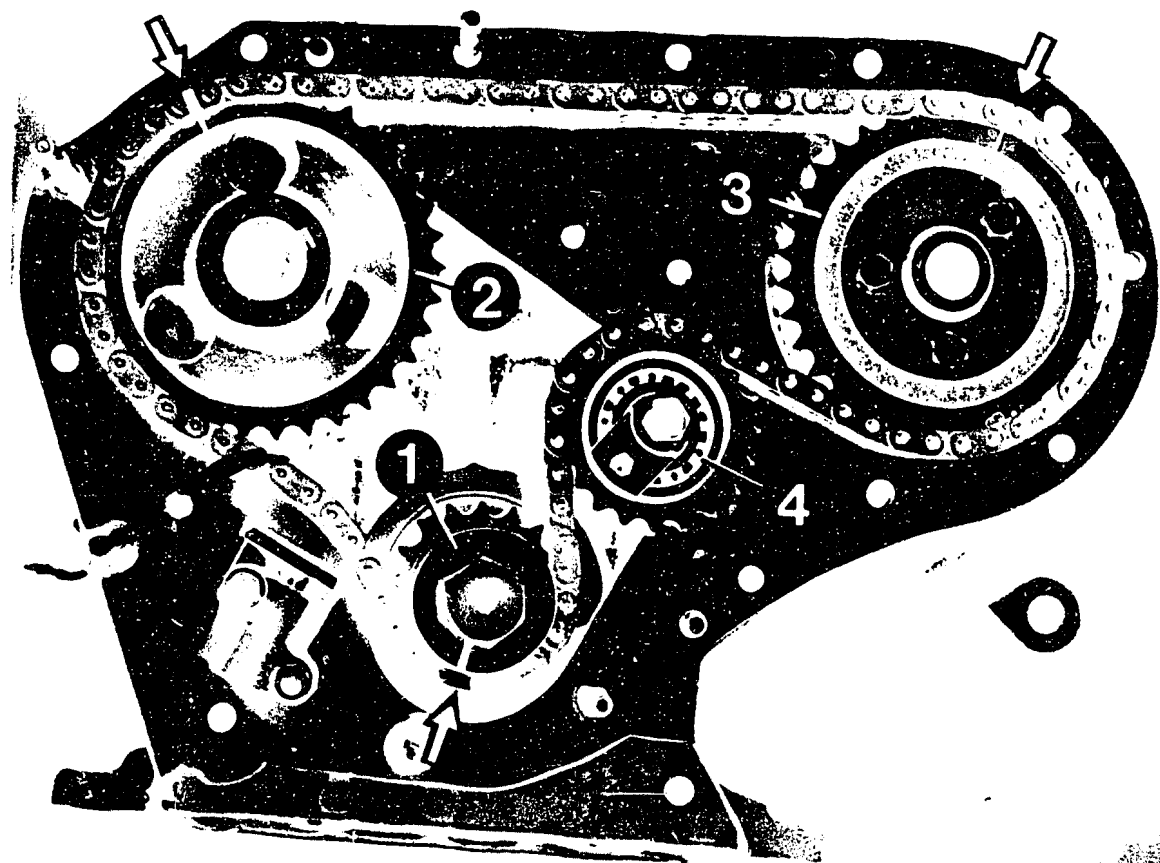
Remove the fan funnel and fan.

Remove the crankshaft pulley and fan wheel.

Remove the V-belt for the fan wheel and crankshaft pulley.

Remove the timing cover.

Screw the crankshaft-pulley fastening screw into the crankshaft gear.

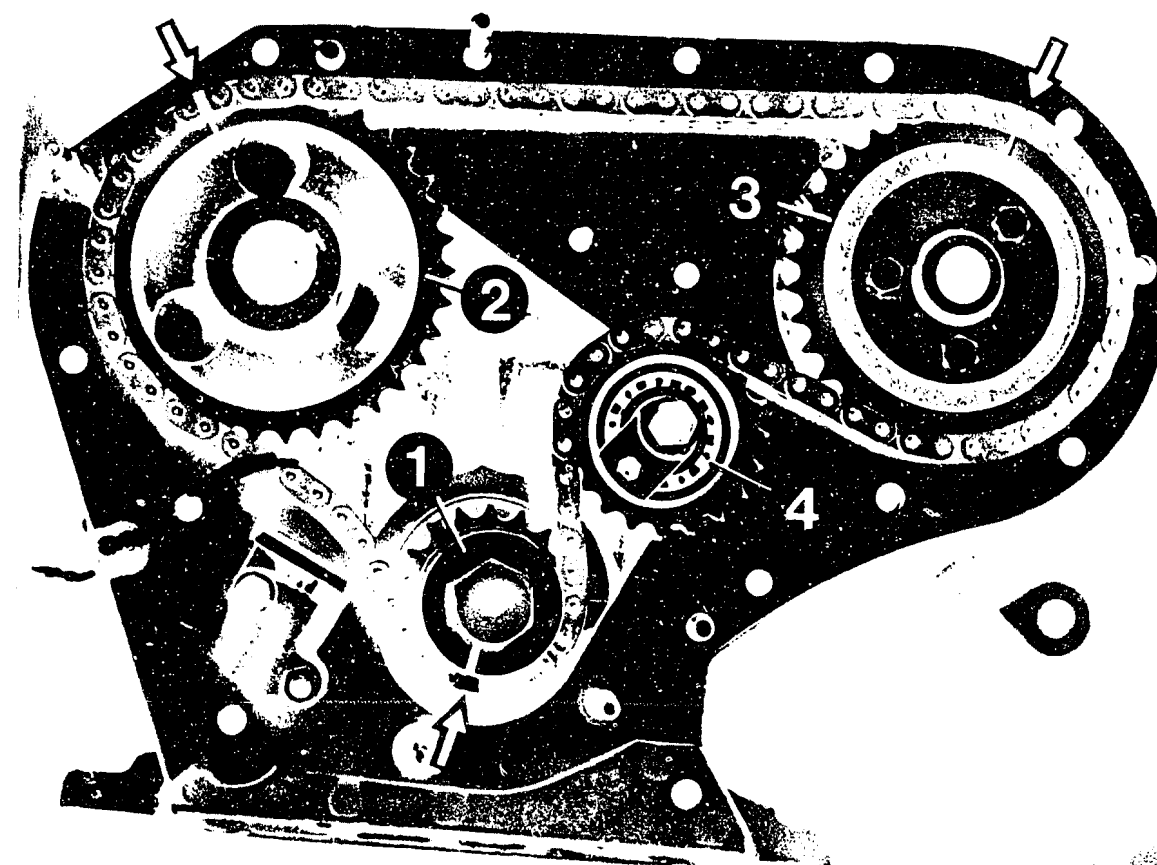


- 1 = Crankshaft gear
- 2 = Camshaft gear
- 3 = Injection-pump drive gear
- 4 = Idler gear

Using the crankshaft gear, turn the crankshaft in the direction of engine rotation until the following marks are in alignment:

- * Mark on crankshaft gear and copper link in chain (see illustration, arrow).
- * Line marks on camshaft gear and chain (see illustration, arrow).
- * Line marks on injection-pump drive gear and chain (see illustration, arrow).

If the marks are not in alignment, adjust the engine timing.



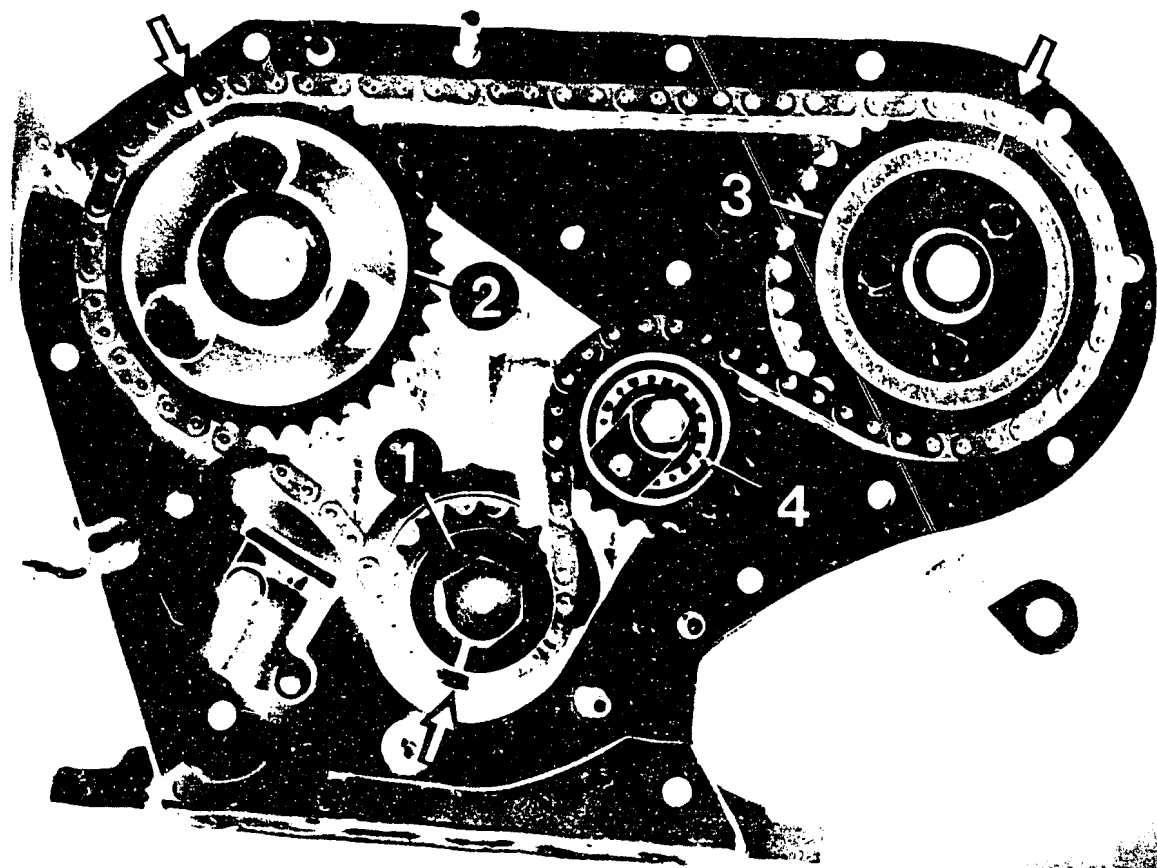
- 1 = Crankshaft gear
- 2 = Camshaft gear
- 3 = Injection-pump drive gear
- 4 = Idler gear

If the marks are in alignment, remove the hexagon screw from the crankshaft gear.

Mount the timing cover.

Install the crankshaft pulley and fan wheel with V-belt.

Mount the fan and install the fan funnel.



- 1 = Crankshaft gear
- 2 = Camshaft gear
- 3 = Injection-pump drive gear
- 4 = Idler gear

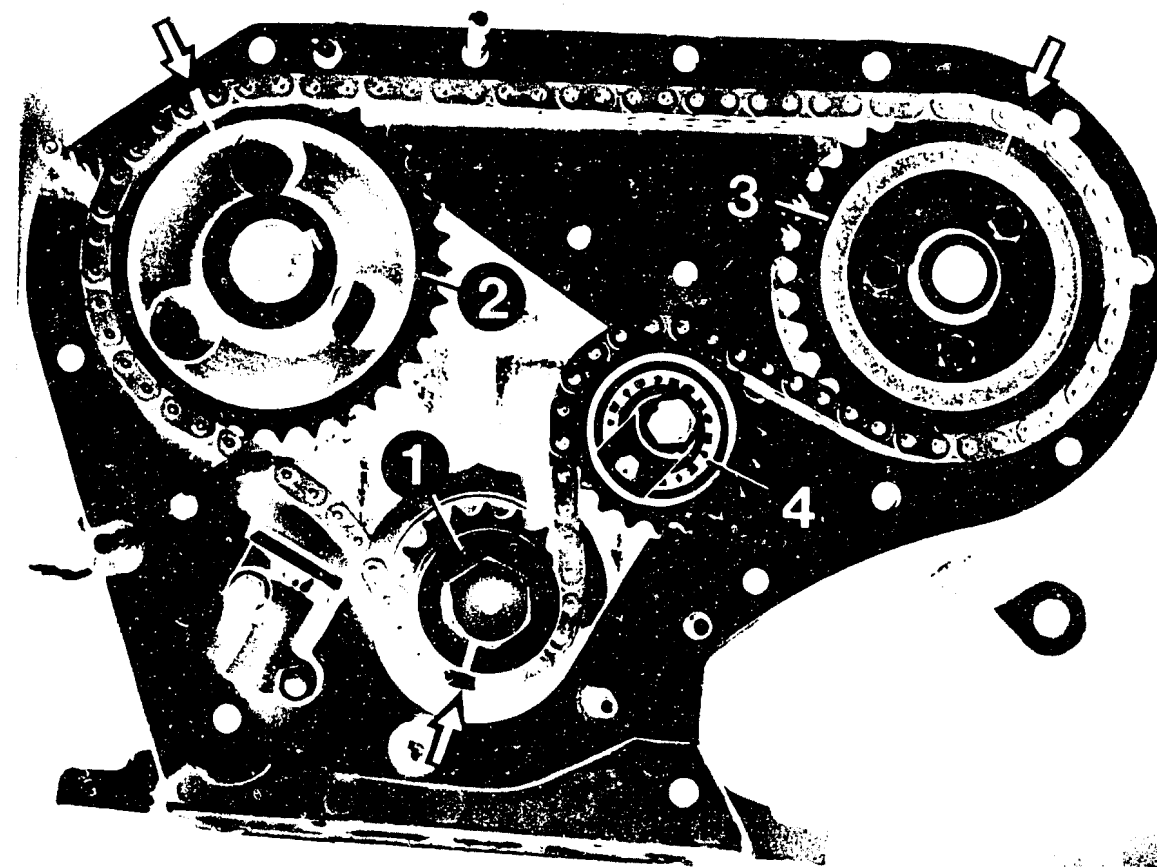
Adjust the engine timing

Relieve the tension on the chain tensioner using a 3 mm hexagon socket. To do this, remove the plug.

Loosen the fastening screw of the idler gear and pivot the eccentric to the right until the timing chain is no longer under tension.

Remove the timing chain.

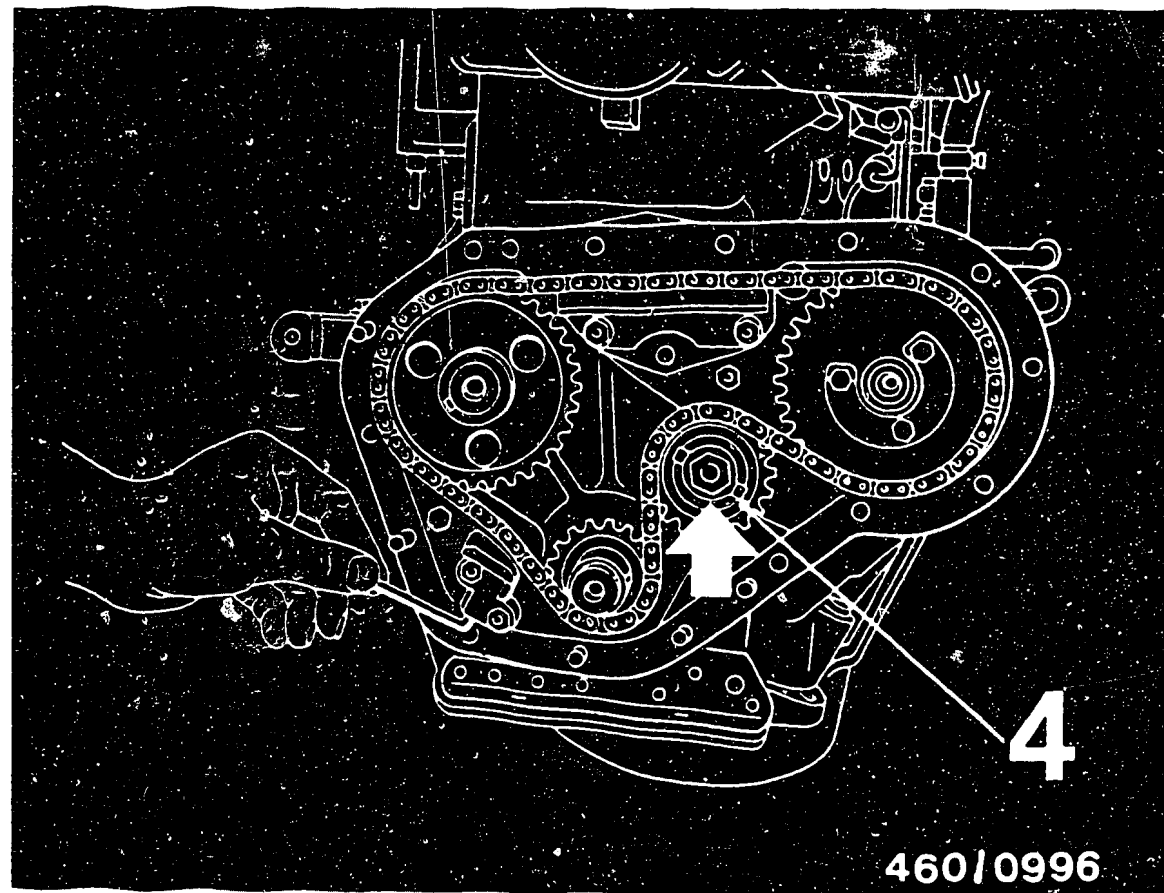
Position the crankshaft gear, camshaft gear and injection-pump drive gear into the correct position with respect to the marks (see illustration, arrows).



- 1 = Crankshaft gear
- 2 = Camshaft gear
- 3 = Injection-pump drive gear
- 4 = Idler gear

Position the timing chain on the crankshaft gear so that the copper link is against the punch mark (see illustration, arrow).

When positioning the timing chain on the other gears, make sure that the line marks on the timing chain and gear are in alignment (see illustration, arrows).



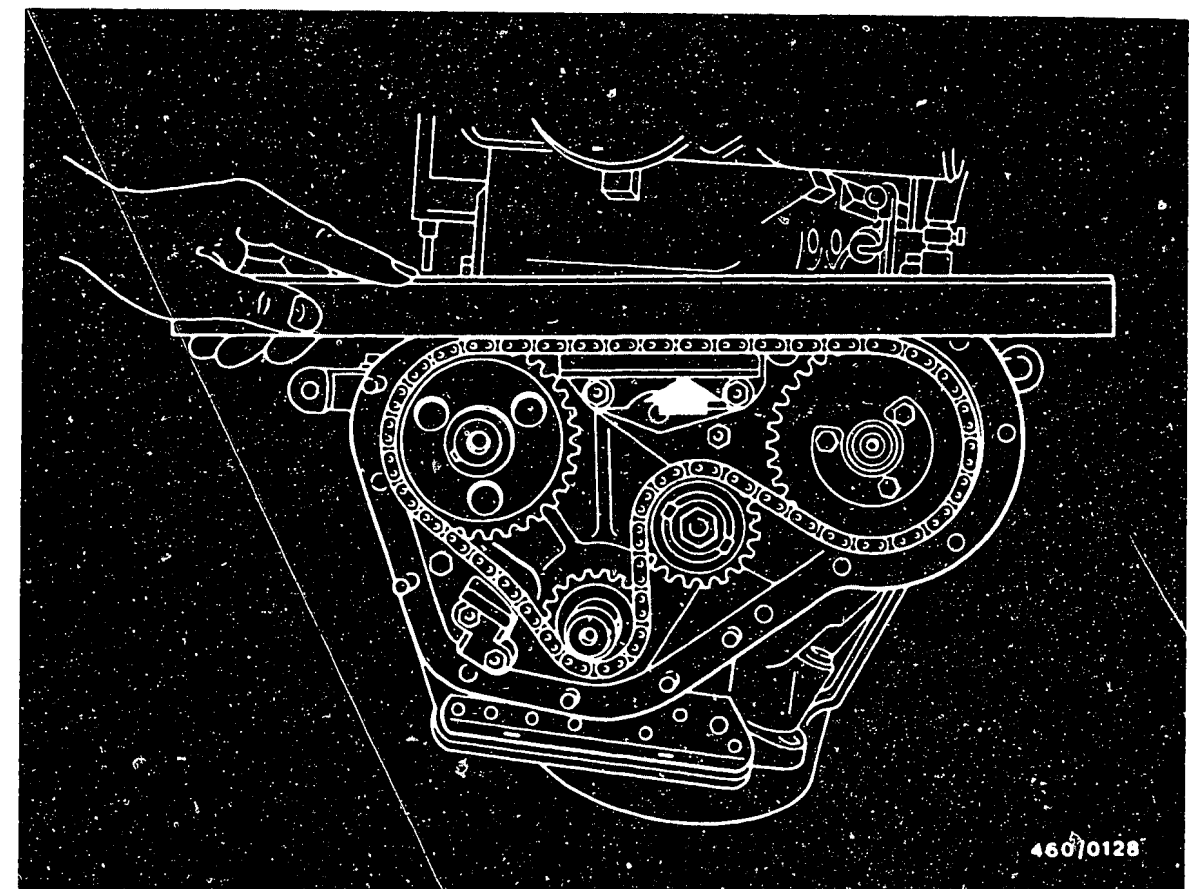
4 = Idler gear

Pivot the idler gear to the left opposed to the direction of engine rotation until there is a gap of 1.0...2.0 mm between the chain-tensioner guide shoe and its support.

Tighten the fastening screw of the idler gear (see illustration, arrow) to 50 Nm.

Preload the spring of the chain tensioner using a hexagon-socket-screw key until the timing chain is up against the guide shoe with zero play.

Mount the screw plug in the chain tensioner.



Lay a straightedge over the camshaft gear and pump gear.

Position the guide shoe (see illustration, arrow) up against the timing chain and tighten the fastening screws.

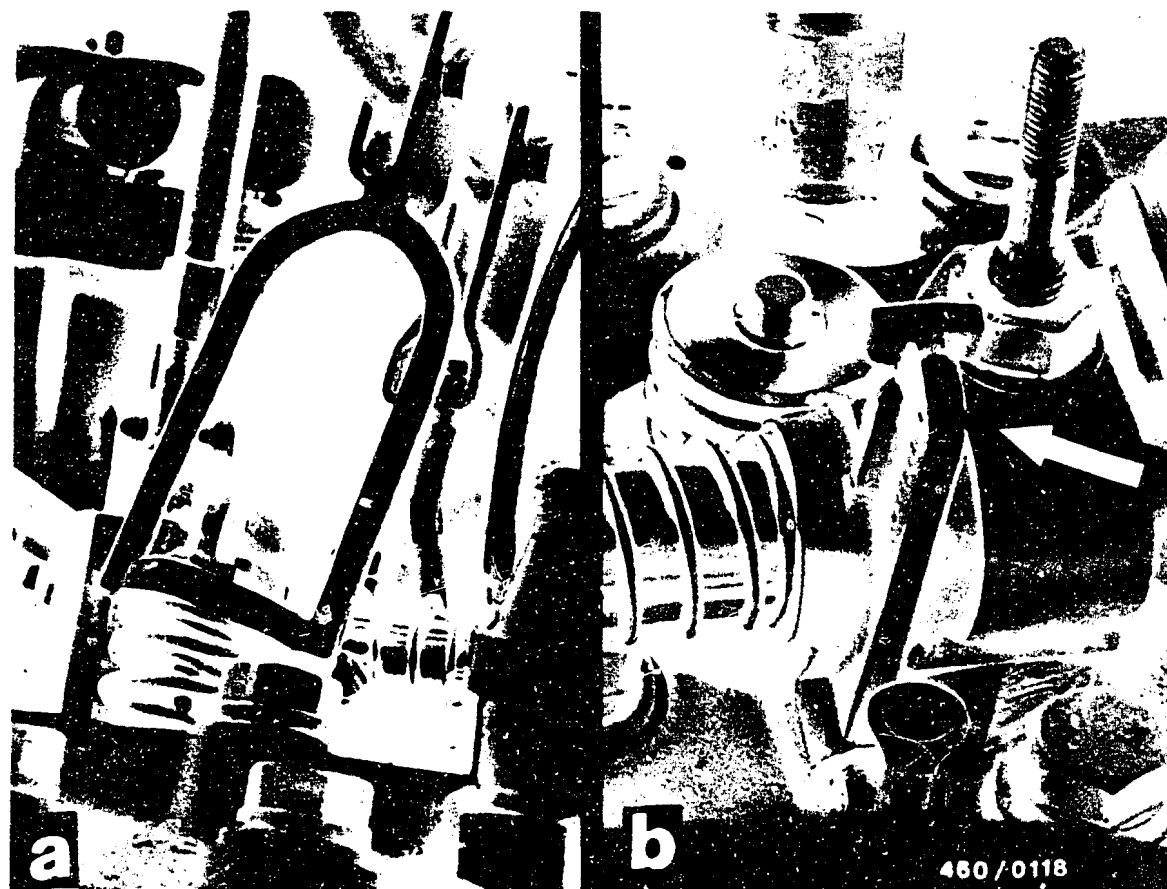
If still mounted, remove the hexagon screw from the crankshaft gear.

Mount the timing cover.

Install the crankshaft pulley and fan wheel with V-belt.

Note:

Later engine versions are without guide shoe.



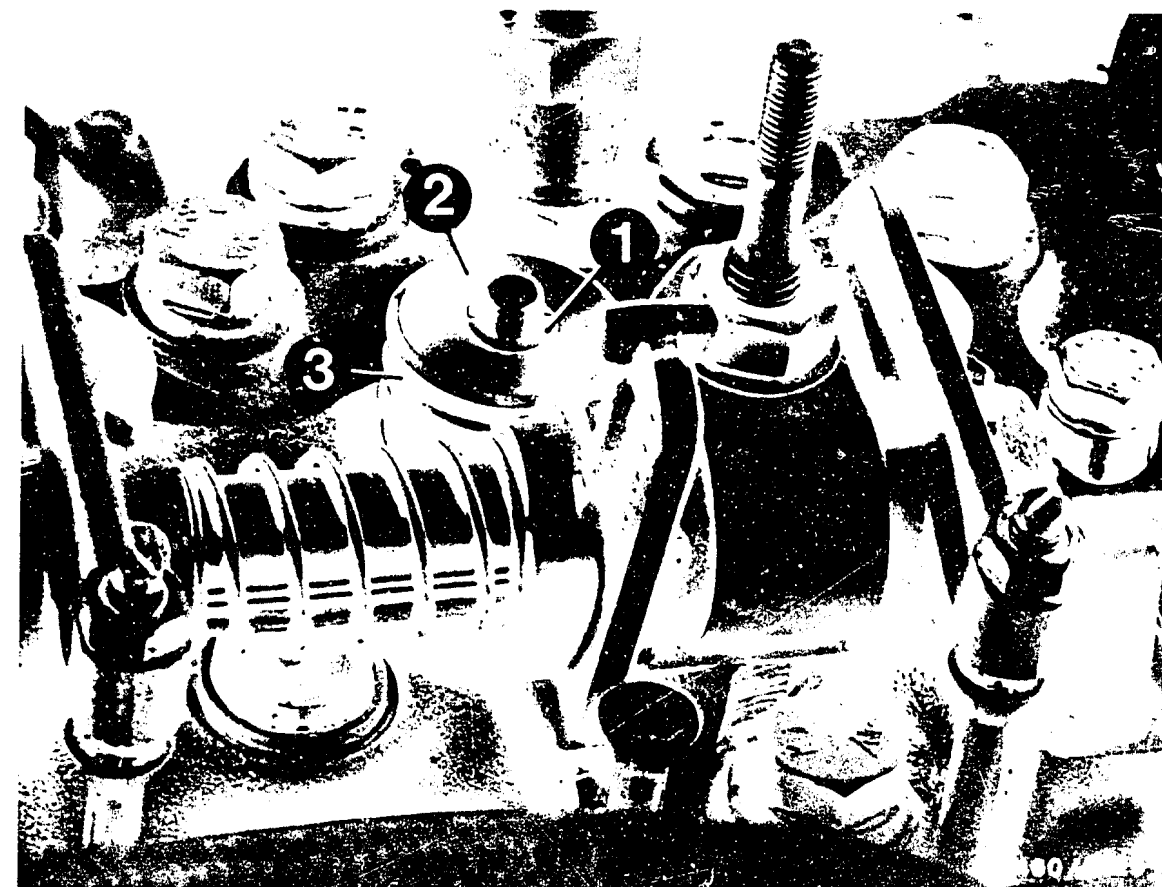
Remove the cylinder-head cover.

Turn the crankshaft so that the exhaust valve just opens with cylinder 1 in BDC position.

Hook tool 976036 (kit KDEP-T 1200) into the rocker-arm shaft and force the exhaust-valve spring on cylinder 4 downward (see illustration a).

Move the rocker arm against the compression spring on the rocker-arm shaft and position vertically.

In this position, bring the rocker arm into the starting position (see illustration b).



- 1 = Collets
- 2 = Spring seat
- 3 = Valve spring

Turn the crankshaft in the direction of engine rotation until cylinder 4 is at TDC.

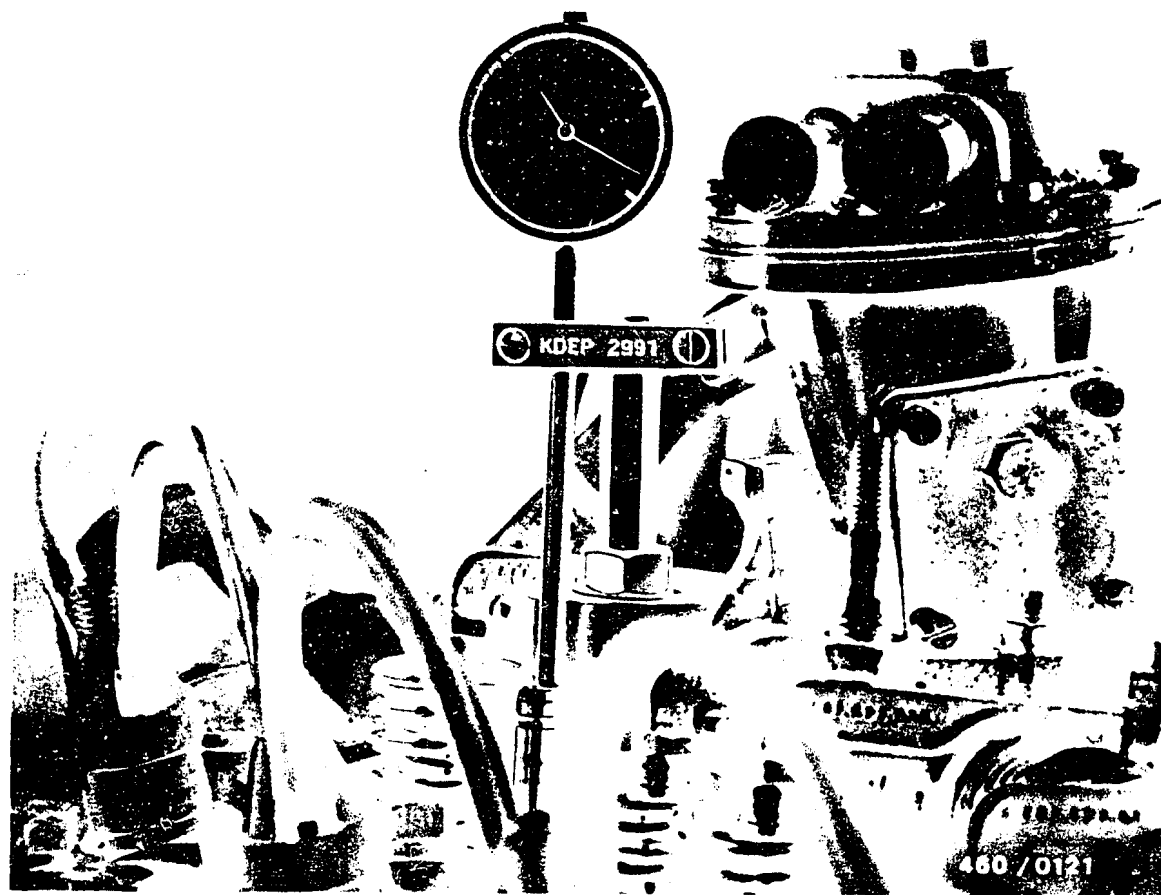
The valves of cylinder 1 are on overlap.

Push the exhaust-valve spring of cylinder 4 downward using tool 976036.

Remove the collets from the exhaust valve.

Relax the valve spring, and remove the spring plate and valve spring from the valve.

The exhaust valve of cylinder 4 is now resting on the engine piston.



Screw the measuring tool KDEP 2991 onto the threaded pin of cylinder 4.

Clamp dial indicator 1 687 233 012 with long measuring base into the measuring tool KDEP 2991.

The measuring base rests on the exhaust valve of cylinder 4.

Preload the dial indicator by approx. 10 mm.

Turn the crankshaft against the direction of engine rotation until the piston has covered a stroke of approx. 7 mm.

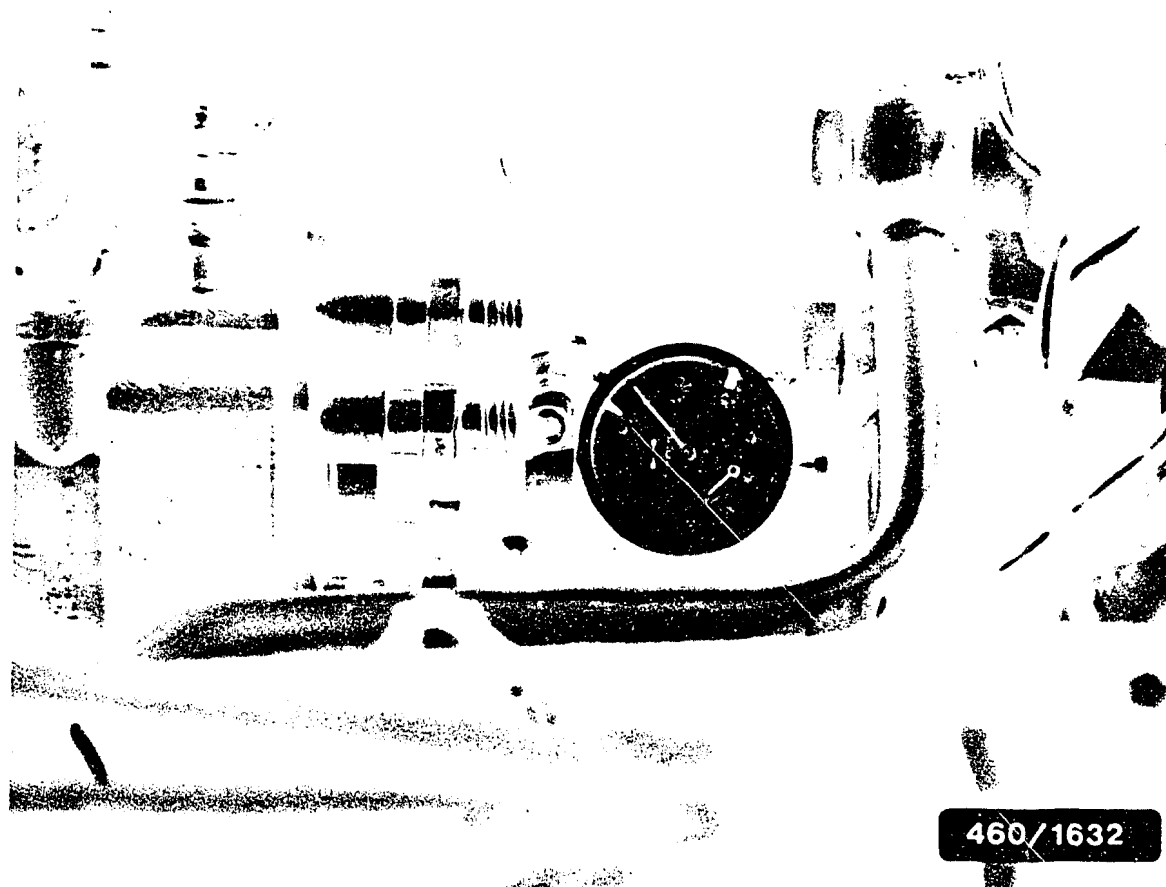
Turn the crankshaft back in the direction of engine rotation until cylinder 4 is at TDC.

Set the dial indicator to "0".



Note on installation:

If the dial indicator 1 687 233 011 or .. 012 is used for setting (injection pump – engine timing), remove the tube from the oil filter (illustration, arrow).



Remove the injection lines.
(Prevent the delivery-valve holders from coming loose by counterholding with a wrench.)

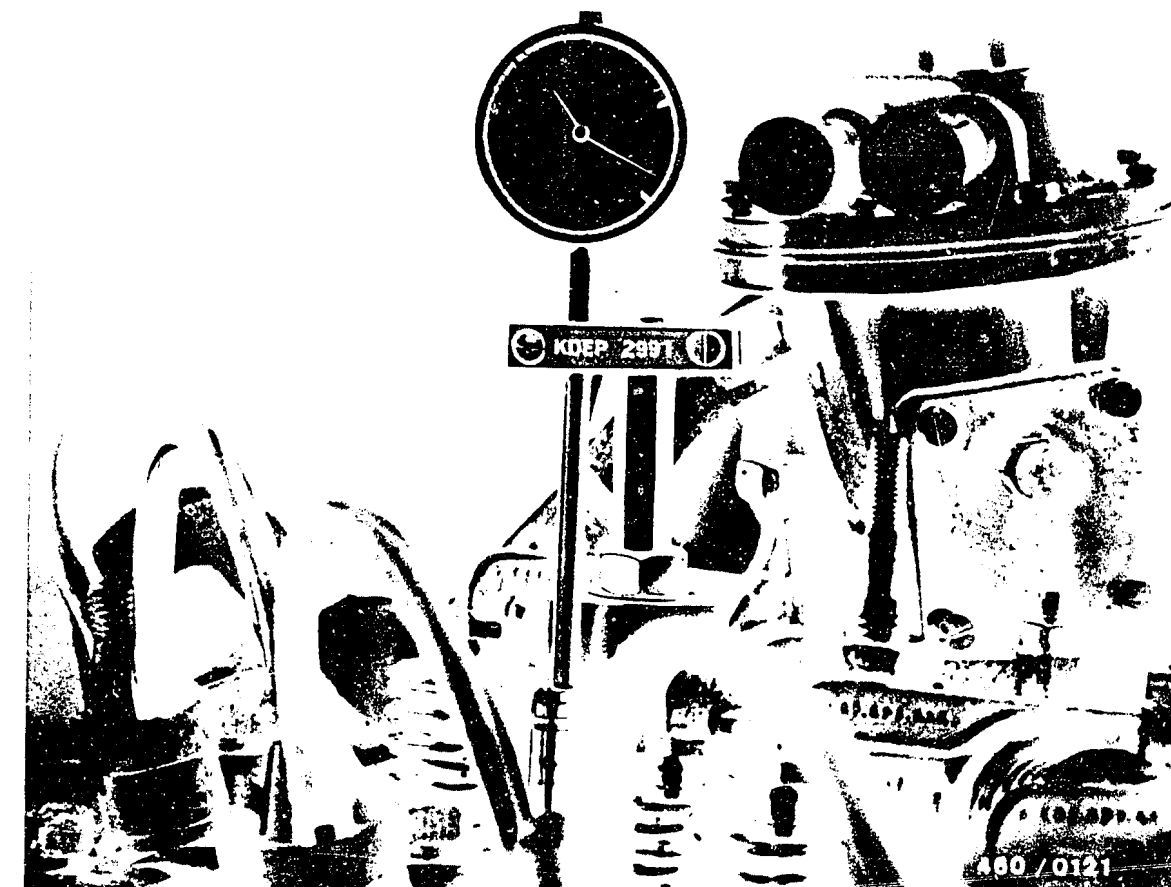
Remove the bleeder screw from the central screw plug (triangular-head bolt) of the injection pump.

Screw measuring tool KDEP 1085 into the bore for the bleeder screw.

Mount the mini dial indicator (see illustration) with measuring base and preload by approx. 3 mm.

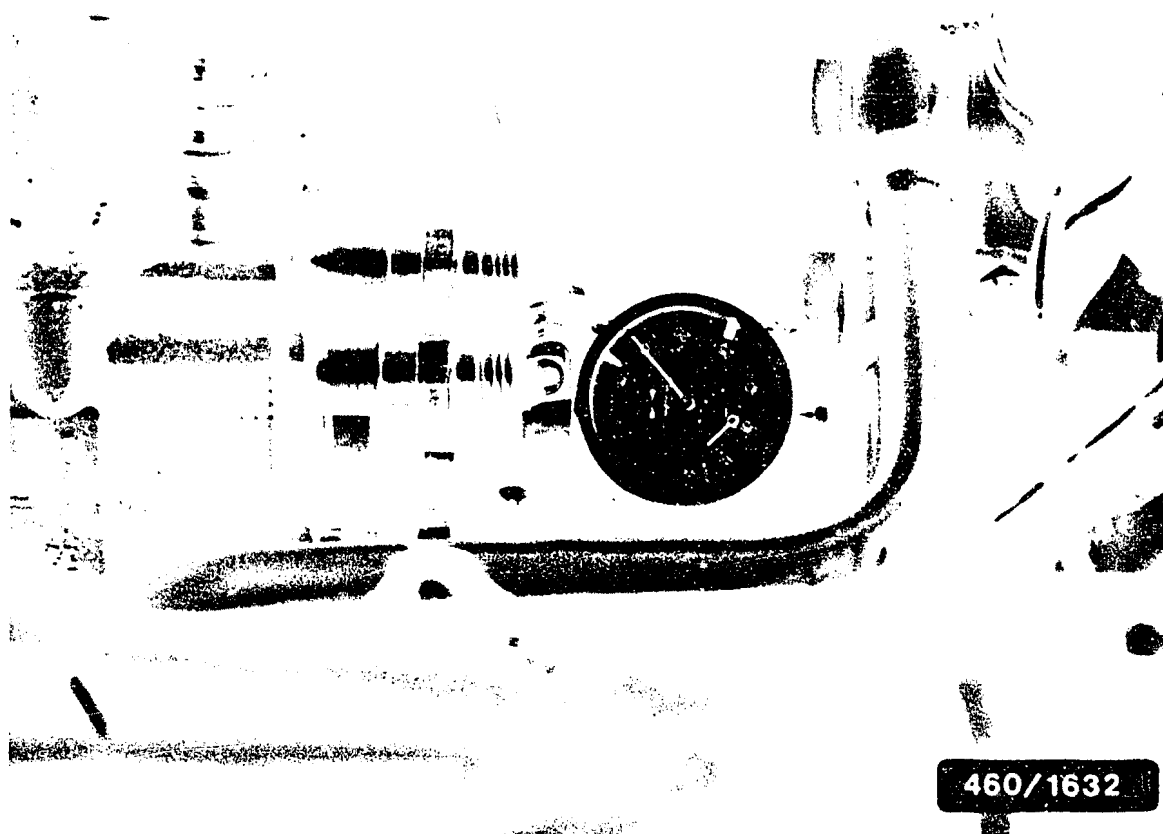
Turn the crankshaft against the direction of engine rotation until the dial indicator indicates the BDC position of the injection-pump plunger.

Set the dial indicator to "0".



Turn the crankshaft in the direction of engine rotation until the dial indicator on the exhaust valve of cylinder 4 indicates the appropriate piston stroke (in mm) before TDC for the engine type.

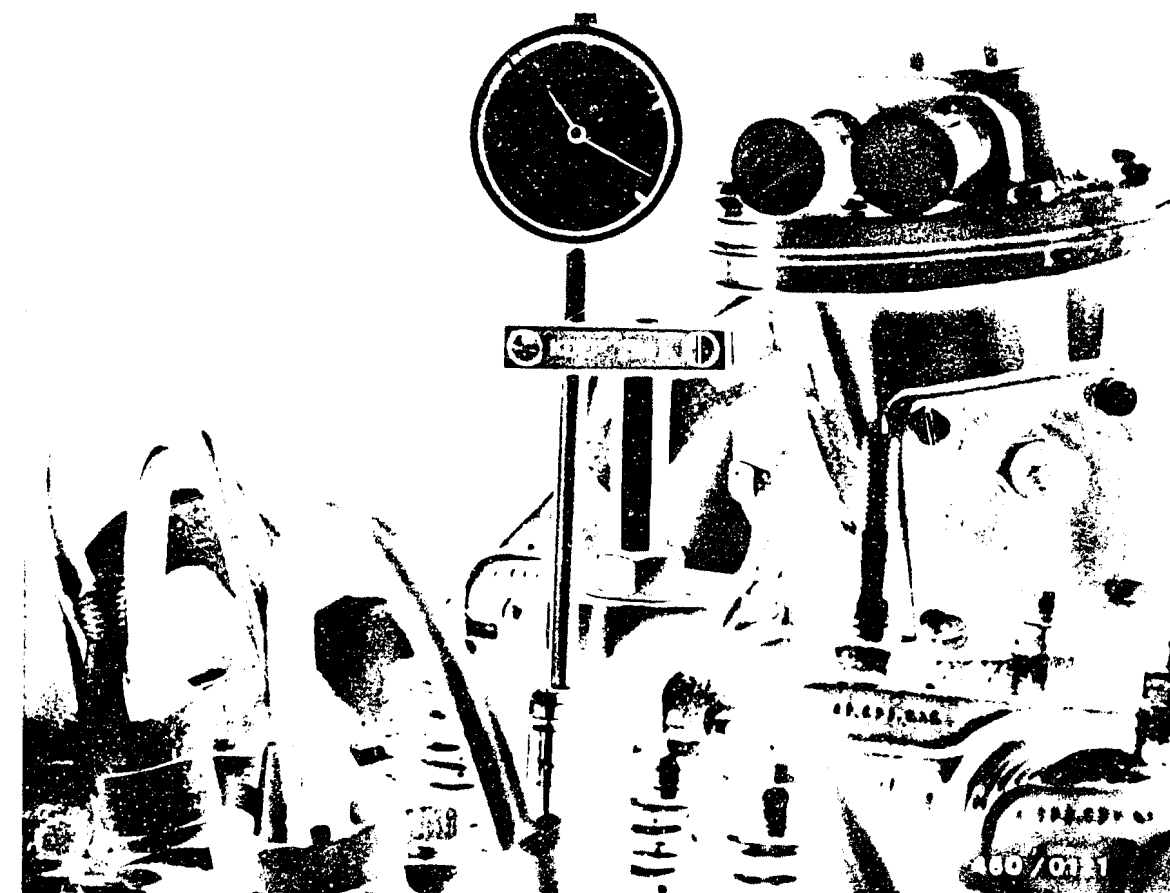
For set values, see brief instructions.



In this engine-piston position, the dial indicator on the injection pump must indicate a stroke in mm (for set value see brief instructions).

If necessary, set the pump-piston stroke by pivoting the injection pump.
(Loosen the fastening screws of the injection pump at the supporting bracket as well.)

Following this, tighten the fastening screws to 20 Nm.

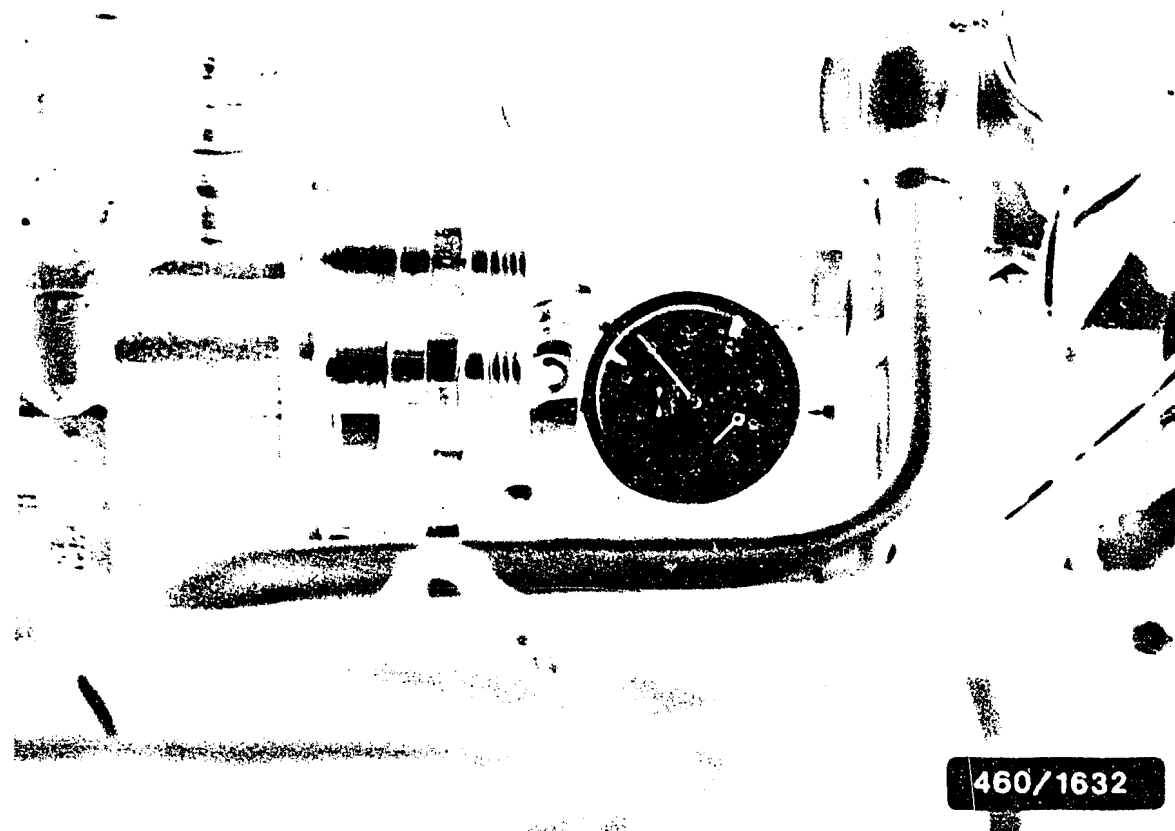


Check the adjustment of the injection pump to the engine (injection timing)

Turn the crankshaft in the direction of engine rotation until cylinder 4 is at TDC.

Check the 0-position of the dial indicator on the exhaust valve.

Turn the crankshaft against the direction of engine rotation until the dial indicator indicates a stroke of approx. 7 mm.



Turn the crankshaft in the direction of engine rotation until the dial indicator on the injection pump indicates a stroke in mm (for set value, see brief instructions).

In this position, the piston of cylinder 4 must be at a set value before TDC (see brief instructions).

Remove measuring tool KDEP 1085 with dial indicator from fuel-injection pump.

Fit bleeder screw with new copper seal ring.

Position engine piston of cylinder 4 at TDC.

Remove measuring tool KDEP 2991 with dial indicator.

Fit valve spring and upper spring seat at exhaust valve of cylinder 4.

Push valve spring downward using tool 976036 (kit KDEP-T 1200).

Install collets of exhaust valve. Relieve tension on valve spring.

Turn the crankshaft so that the exhaust valve of cylinder 1 is just open at the BDC position of the piston.

Push the valve spring of the exhaust valve of cylinder 4 downward together with spring seat.

Push rocker arm so that it makes contact with the spring of the rocker-arm shaft and position horizontally.

Guide the rocker arm in this position onto the exhaust valve and tap it.

Remove tool 976036.

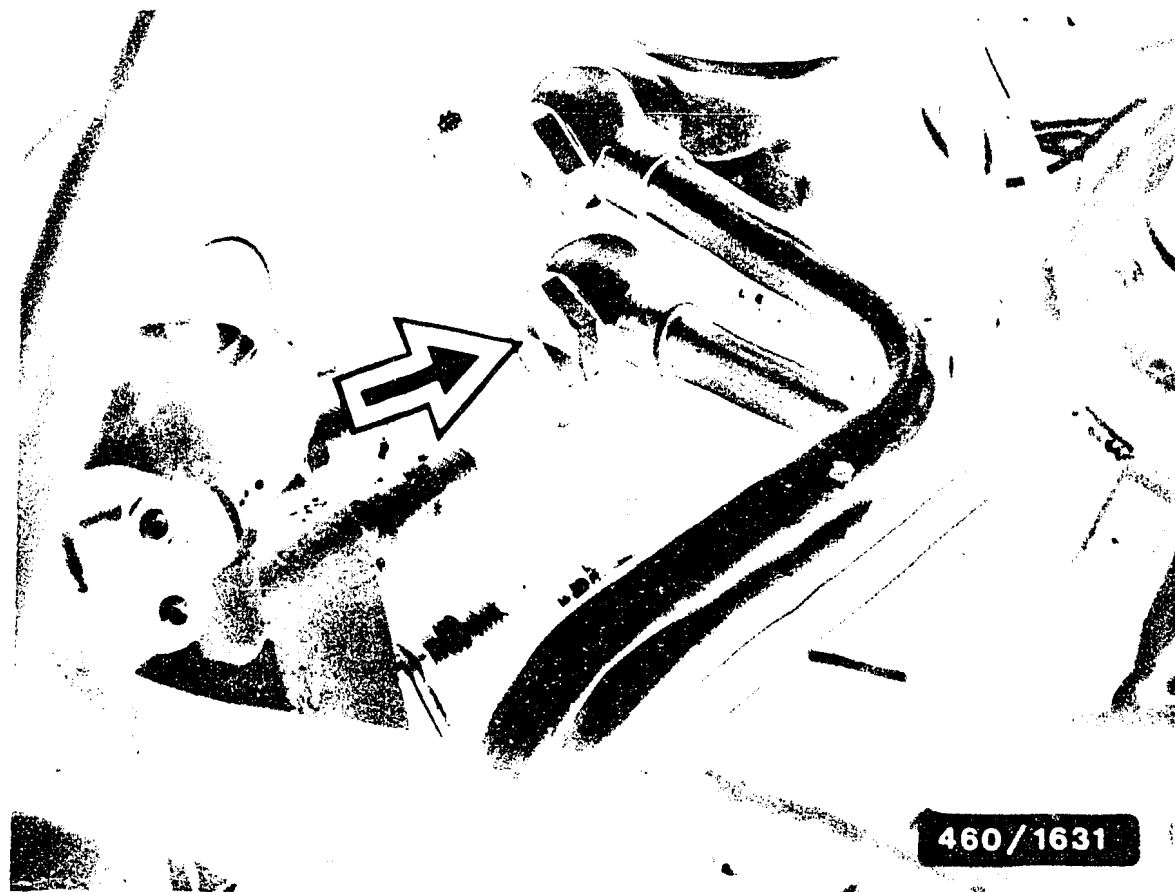
Check the valve clearance.

Test/adjust the valve clearance only when the engine is cold (approx. +20°C):

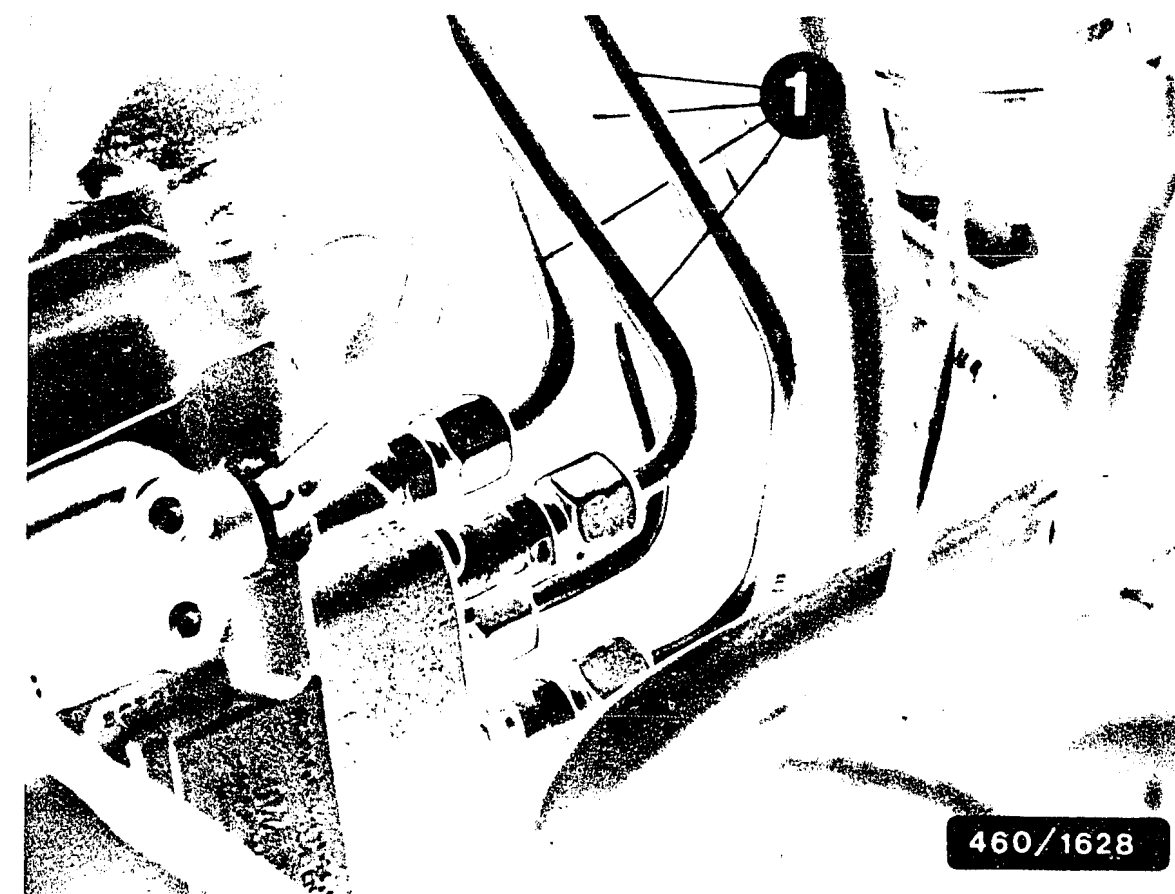
Inlet valve: 0.15...0.20 mm

Exhaust valve: 0.25...0.30 mm

Mount the cylinder-head cover.



If the dial indicator 1 687 233 011 or .. 012 was used for adjusting (injection pump - engine timing), re-mount the lower tube onto the oil filter (illustration, arrow).



1 = Fuel-injection lines

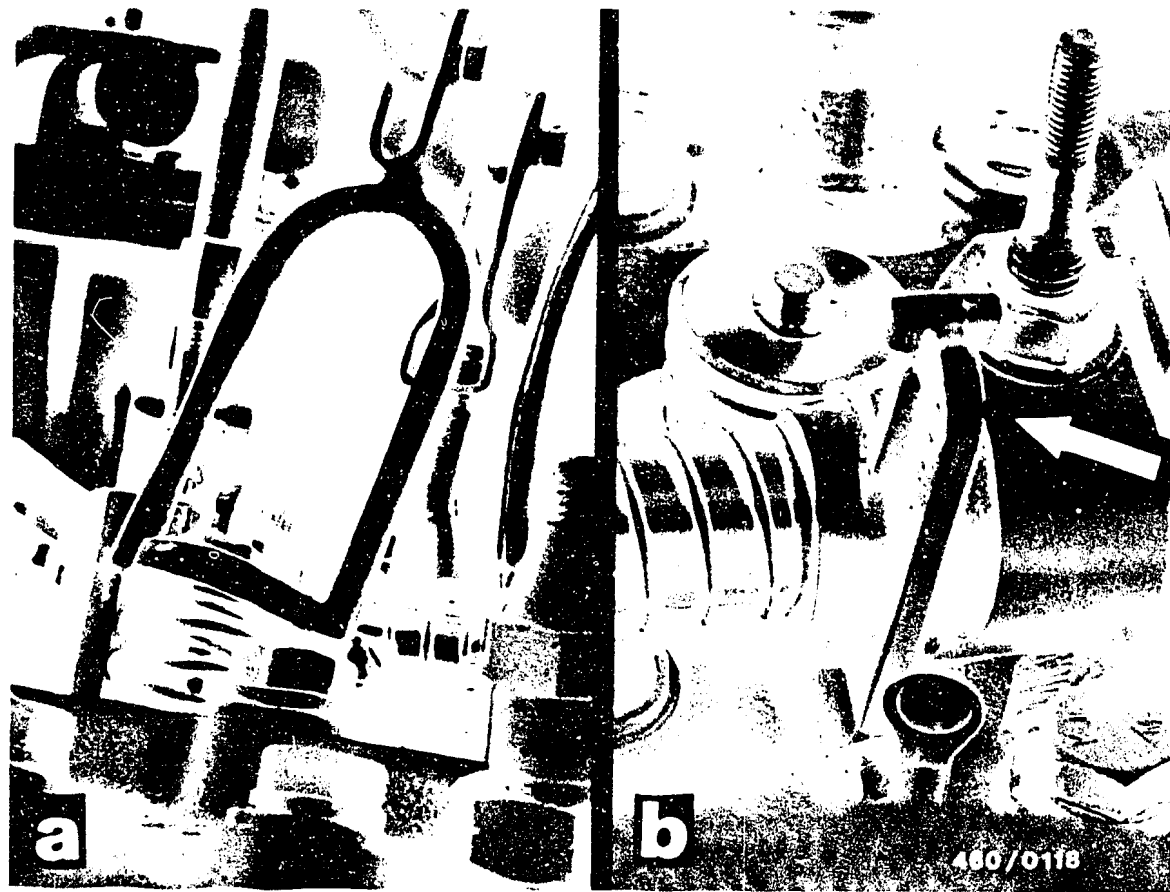
Tighten the fuel-injection lines using open box wrench KDEP 1115.
(Prevent the delivery-valve holders from turning by counterholding with a wrench.)

Align the support bracket on the hydraulic head of the injection pump so that it is up against the cylinder block and hydraulic head free of tension.

Screw down the support bracket.

If necessary, bleed the injection system.

Return to trouble-shooting chart B04



COORDINATION, INJECTION-PUMP - ENGINE (INJECTION TIMING)

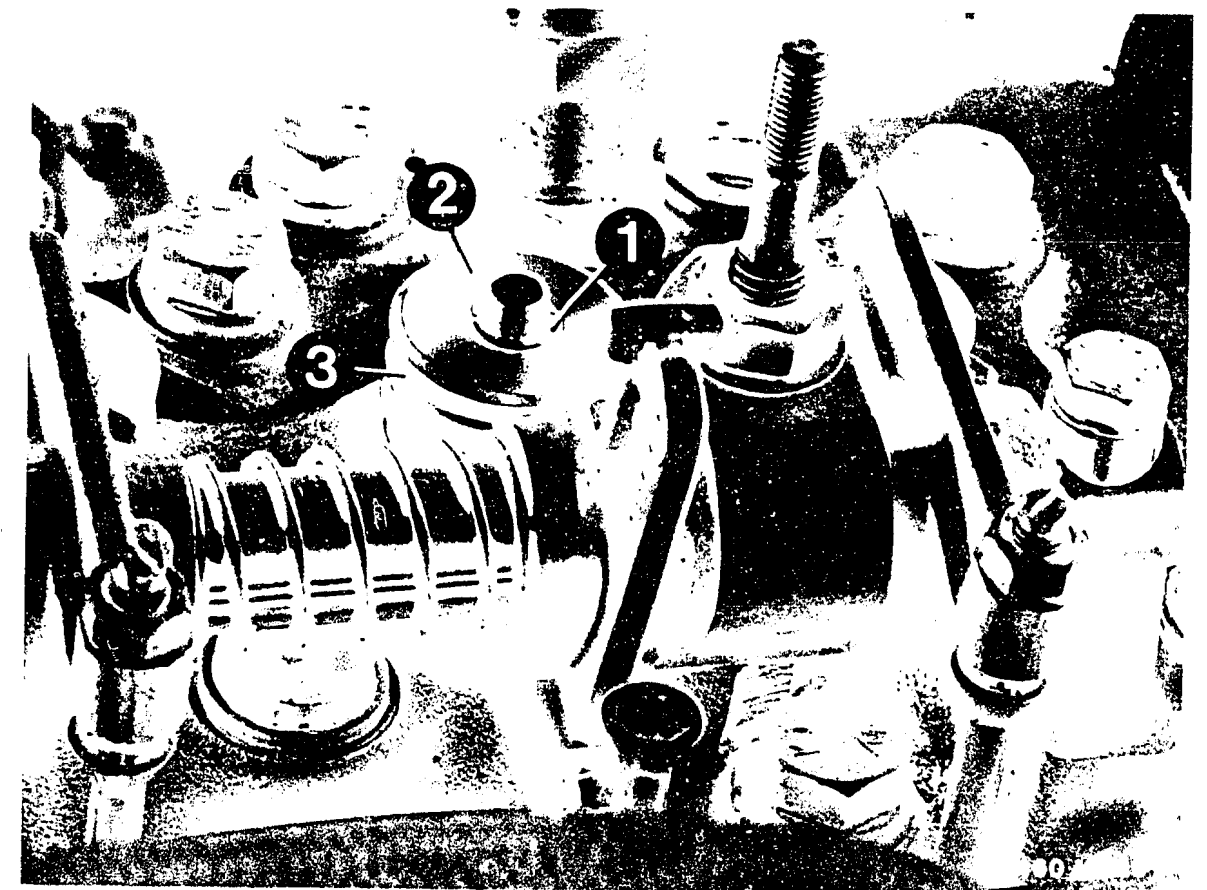
Remove the cylinder-head cover.

Turn the crankshaft so that the exhaust valve just opens with cylinder 1 in BDC position.

Hook tool 976036 (kit KDEP-T 1200) into the rocker-arm shaft and force the exhaust-valve spring on cylinder 4 downward (see illustration a).

Move the rocker arm against the compression spring on the rocker-arm shaft and position vertically.

In this position, bring the rocker arm into the starting position (see illustration b).



- 1 = Collets
- 2 = Spring seat
- 3 = Valve spring

Turn the crankshaft in the direction of engine rotation until cylinder 4 is at TDC.

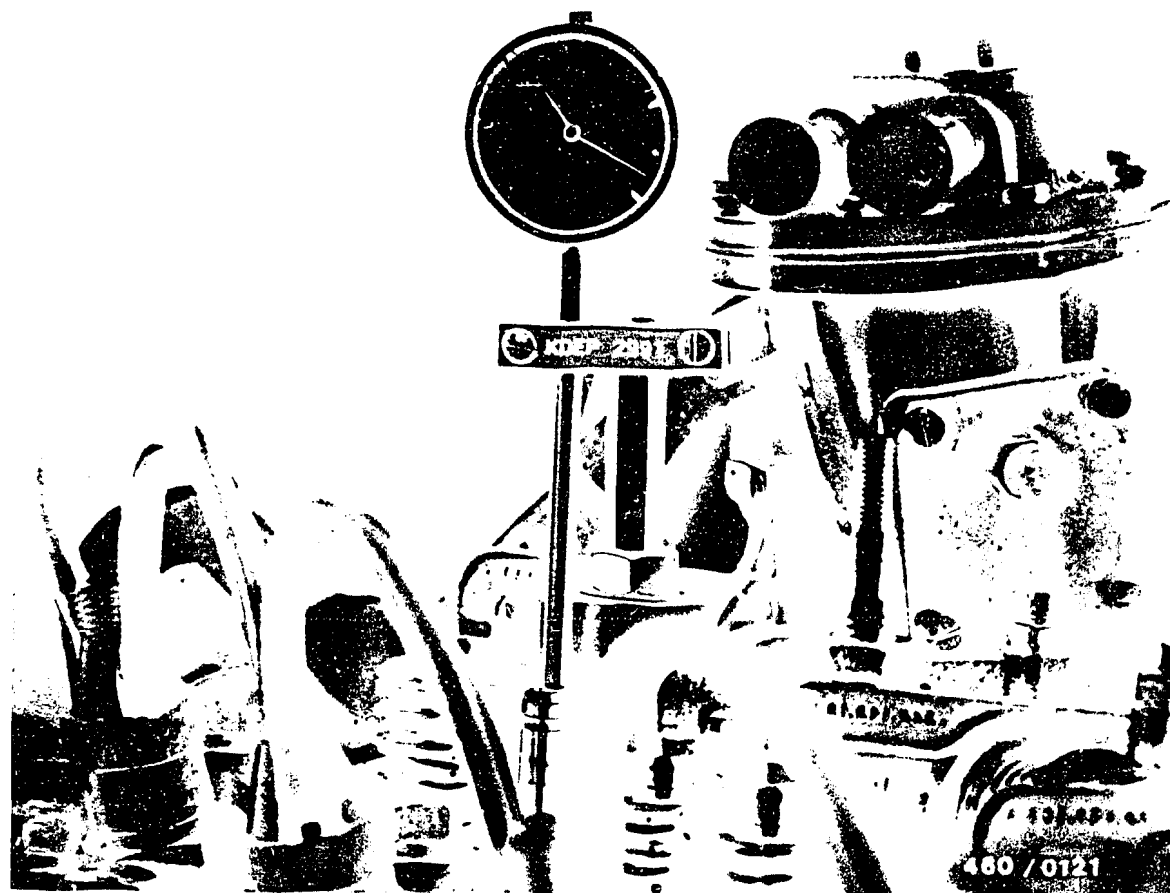
The valves of cylinder 1 are on overlap.

Push the exhaust-valve spring of cylinder 4 downward using tool 976036.

Remove the collets from the exhaust valve.

Relax the valve spring, and remove the spring plate and valve spring from the valve.

The exhaust valve of cylinder 4 is now resting on the engine piston.



Screw the measuring tool KDEP 2991 onto the threaded pin of cylinder 4.

Clamp dial indicator 1 687 233 012 with long measuring base into the measuring tool KDEP 2991.

The measuring base rests on the exhaust valve of cylinder 4.

Preload the dial indicator by approx. 10 mm.

Turn the crankshaft against the direction of engine rotation until the piston has covered a stroke of approx. 7 mm.

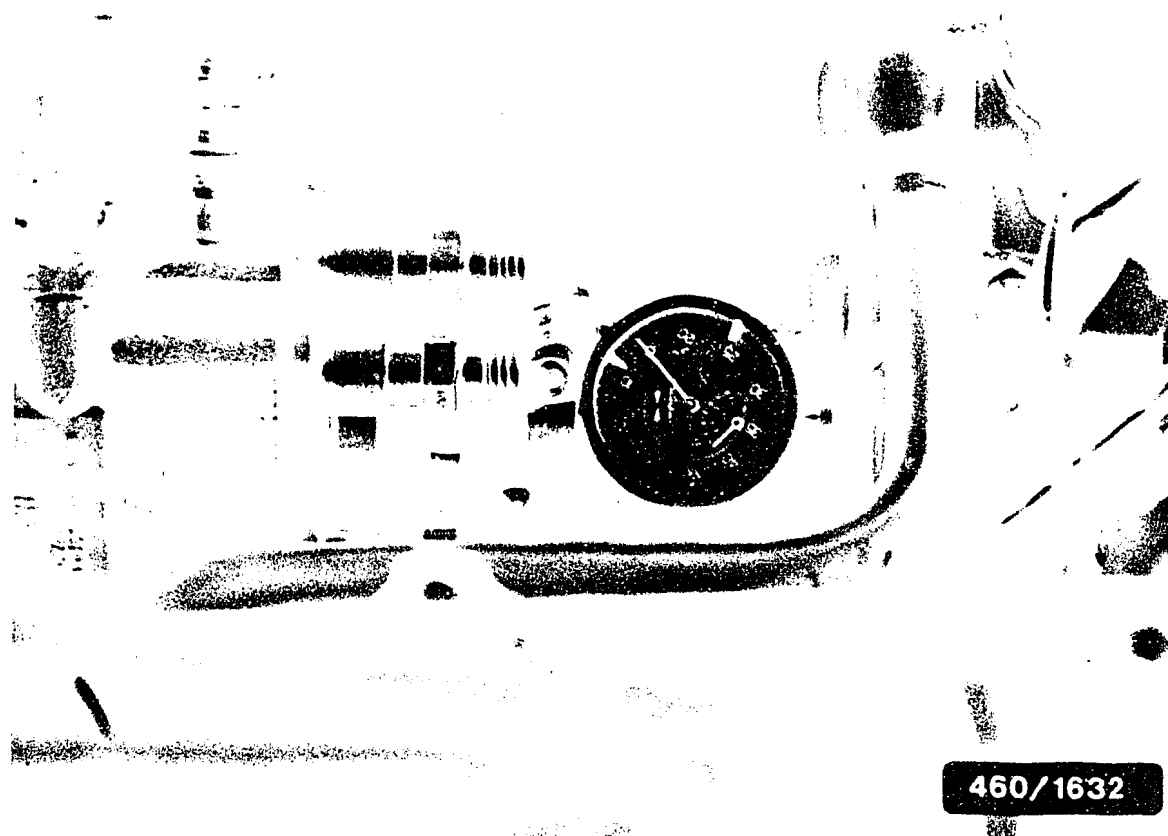
Turn the crankshaft back in the direction of engine rotation until cylinder 4 is at TDC.

Set the dial indicator to "0".



Note on installation:

If the dial indicator 1 687 233 011 or .. 012 is used for setting (injection pump – engine timing), remove the tube from the oil filter (illustration, arrow).



Remove the injection lines.
(Prevent the delivery-valve holders from coming loose by counterholding with a wrench.)

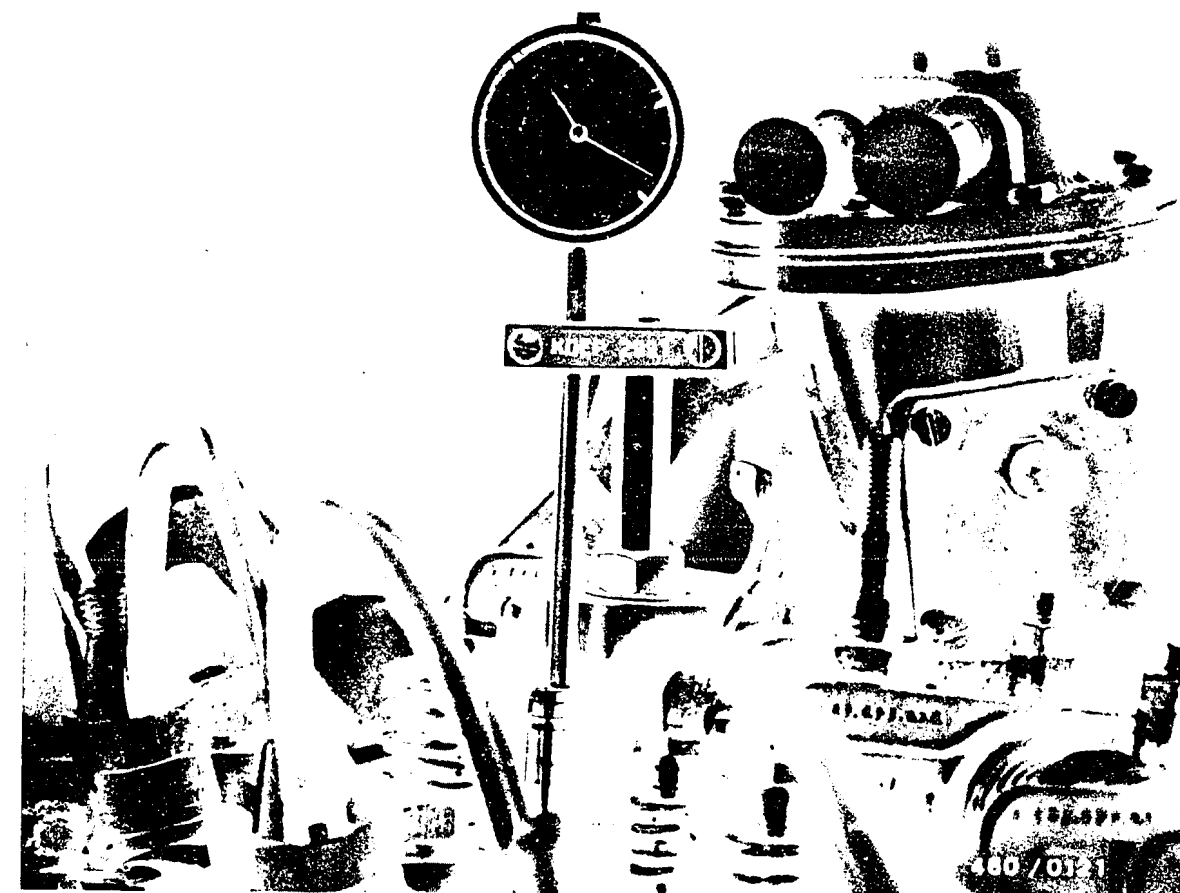
Remove the bleeder screw from the central screw plug (triangular-head bolt) of the injection pump.

Screw measuring tool KDEP 1085 into the bore for the bleeder screw.

Mount the mini dial indicator (see illustration) with measuring base and preload by approx. 3 mm.

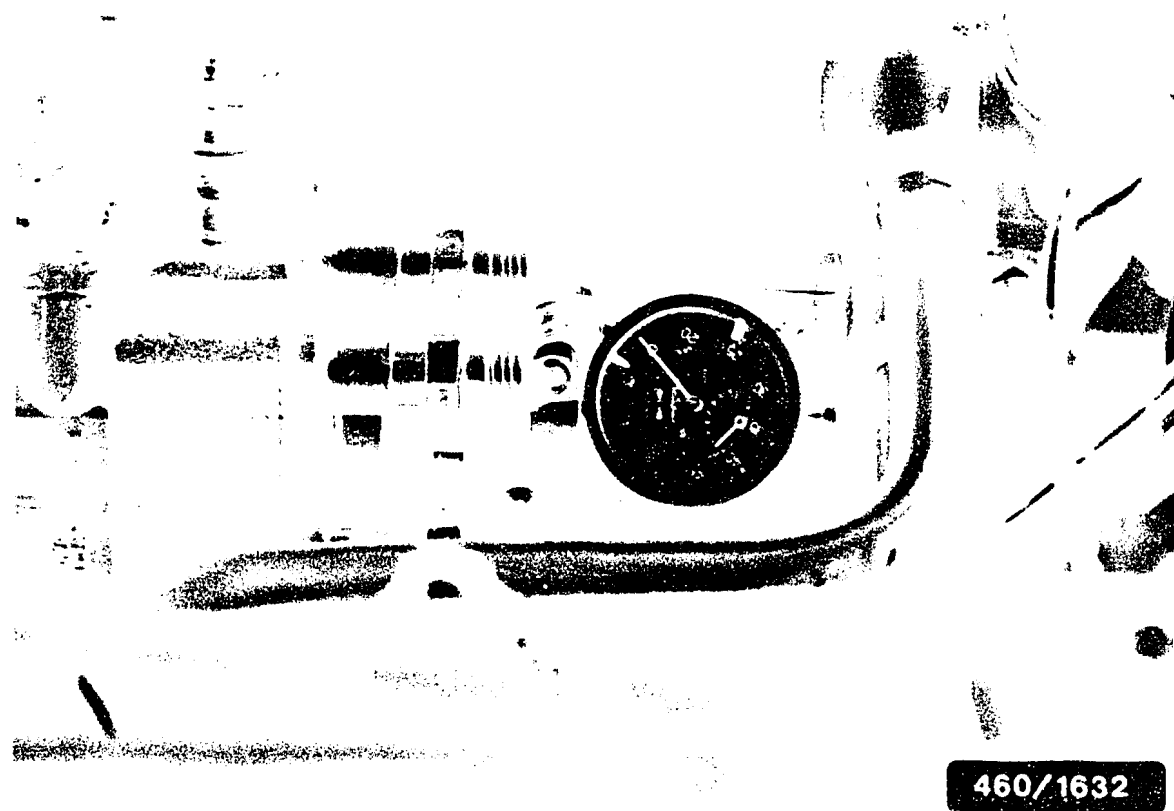
Turn the crankshaft against the direction of engine rotation until the dial indicator indicates the BDC position of the injection-pump plunger.

Set the dial indicator to "0".



Turn the crankshaft in the direction of engine rotation until the dial indicator on the exhaust valve of cylinder 4 indicates the appropriate piston stroke (in mm) before TDC for the engine type.

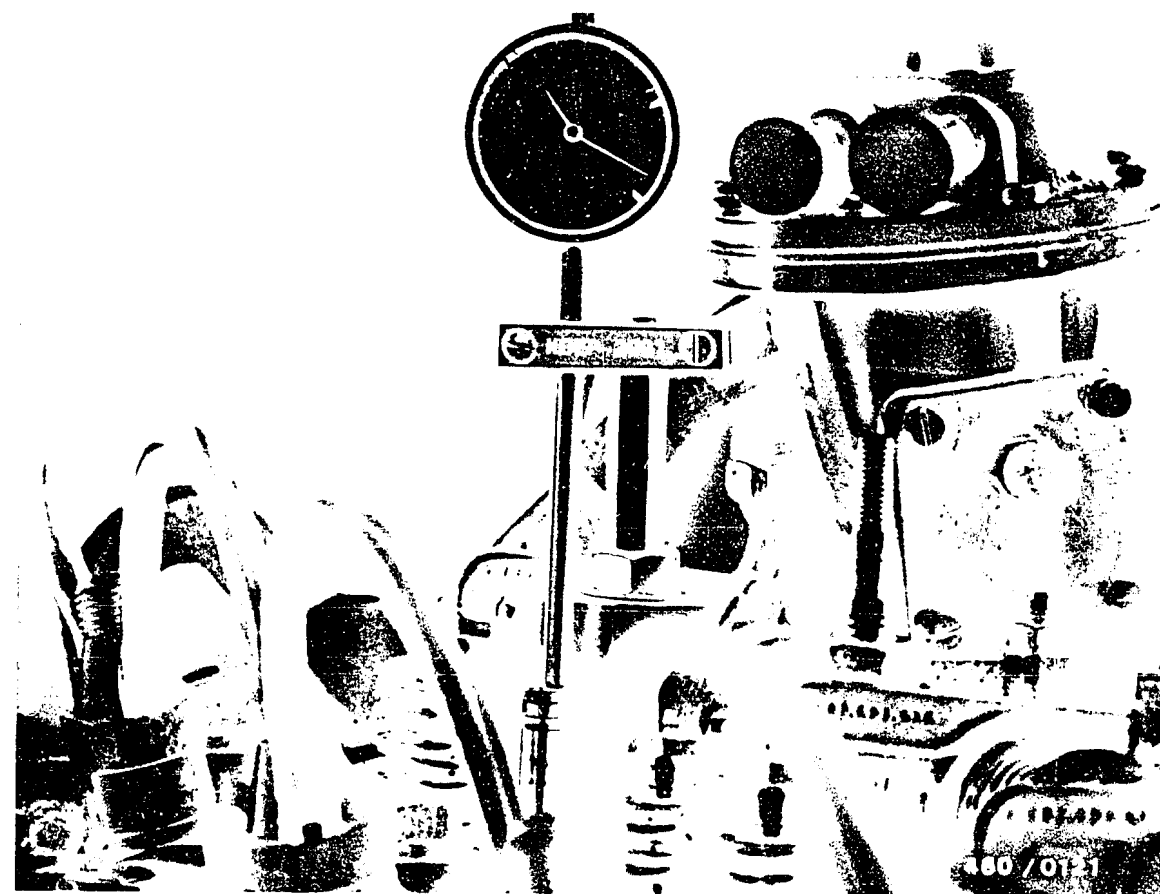
For set value: see brief instructions.



In this engine-piston position, the dial indicator on the injection pump must indicate a stroke in mm (for set value see brief instructions).

If necessary, set the pump-piston stroke by pivoting the injection pump.
(Loosen the fastening screws of the injection pump at the supporting bracket as well.)

Following this, tighten the fastening screws to 20 Nm.

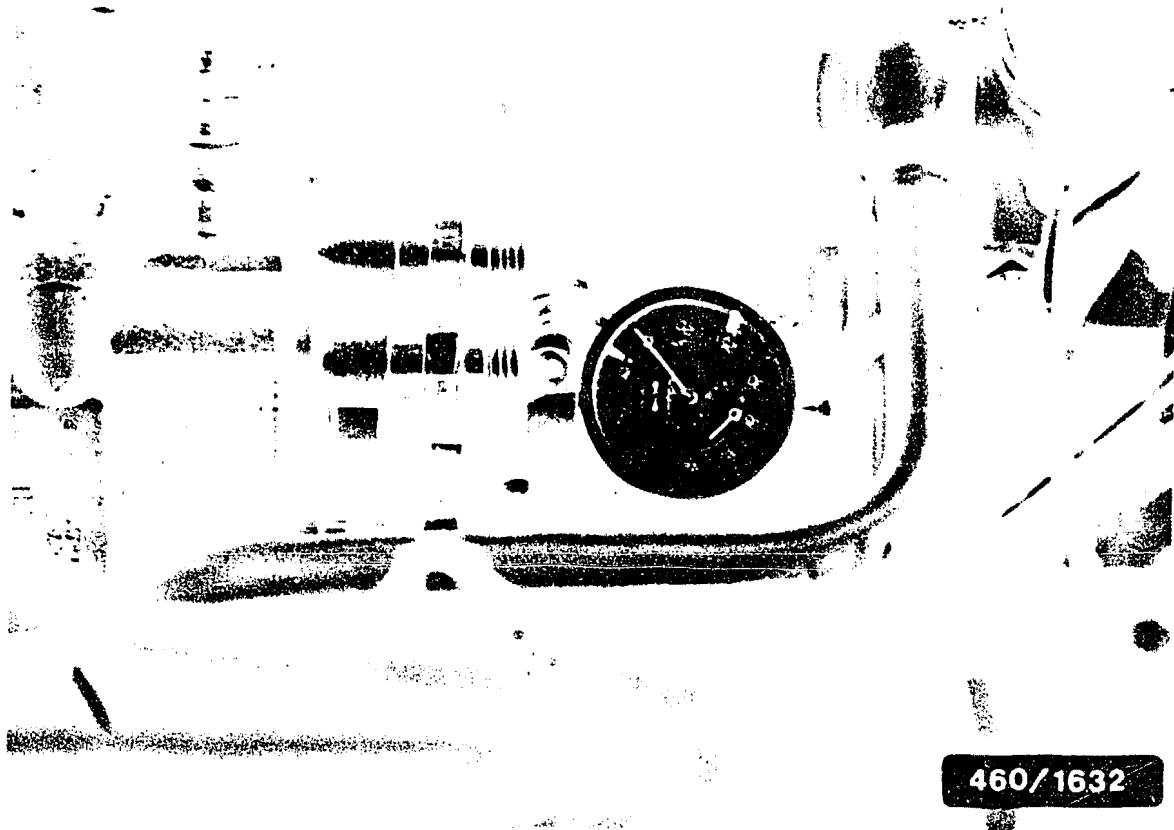


Check the adjustment of the injection pump to the engine (injection timing)

Turn the crankshaft in the direction of engine rotation until cylinder 4 is at TDC.

Check the 0-position of the dial indicator on the exhaust valve.

Turn the crankshaft against the direction of engine rotation until the dial indicator indicates a stroke of approx. 7 mm.



Turn the crankshaft in the direction of engine rotation until the dial indicator on the injection pump indicates a stroke in mm (for set value, see brief instructions).

In this position, the piston of cylinder 4 must be at a set value before TDC (see brief instructions).

Remove measuring tool KDEP 1085 with dial indicator from fuel-injection pump.

Fit bleeder screw with new copper seal ring.

Position engine piston of cylinder 4 at TDC.

Remove measuring tool KDEP 2991 with dial indicator.

Fit valve spring and upper spring seat at exhaust valve of cylinder 4.

Push valve spring downward using tool 976036 (kit KDEP-T 1200).

Install collets of exhaust valve. Relieve tension on valve spring.

Turn the crankshaft so that the exhaust valve of cylinder 1 is just open at the BDC position of the piston.

Push the valve spring of the exhaust valve of cylinder 4 downward together with spring seat.

Push rocker arm so that it makes contact with the spring of the rocker-arm shaft and position horizontally.

Guide the rocker arm in this position onto the exhaust valve and tap it.

Remove tool 976036.

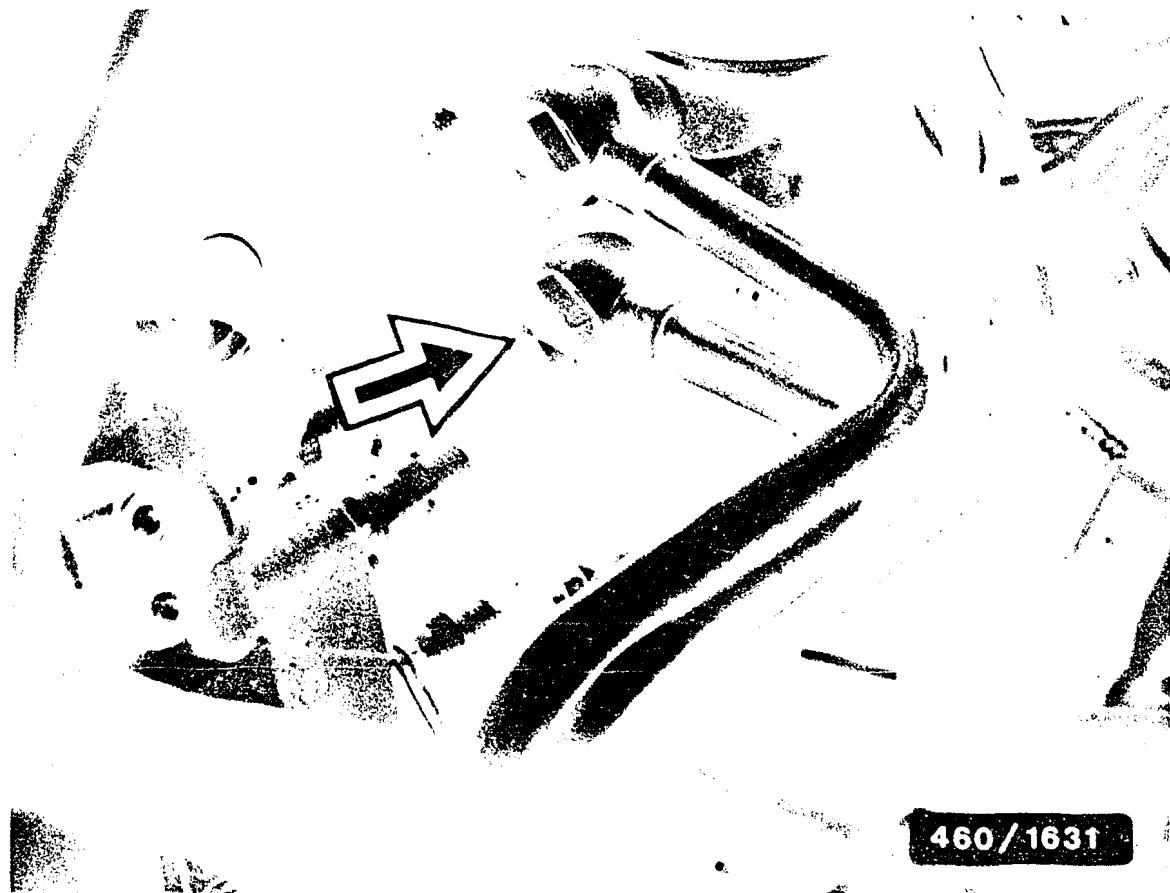
Check the valve clearance.

Test/adjust the valve clearance only when the engine is cold (approx. +20°C):

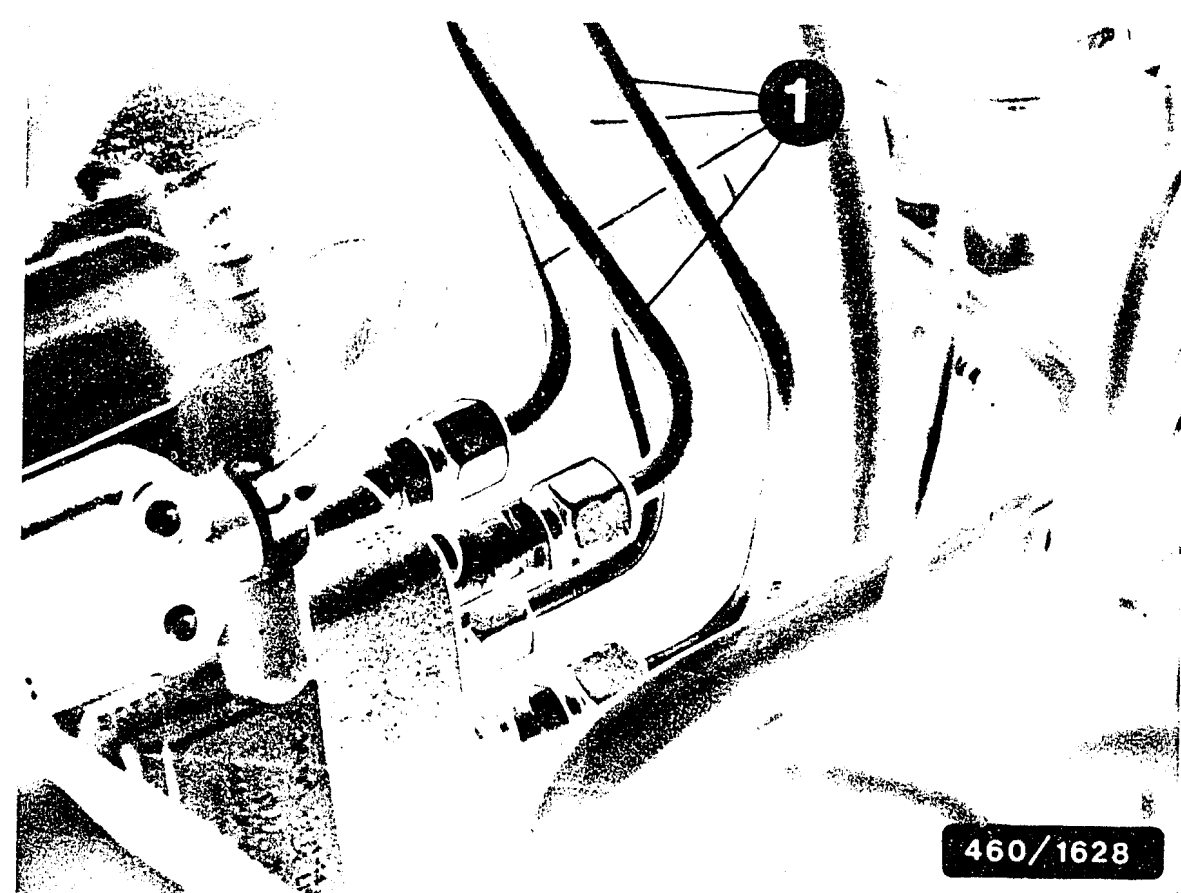
Inlet valve: 0.15...0.20 mm

Exhaust valve: 0.25...0.30 mm

Mount the cylinder-head cover.



If the dial indicator 1 687 233 011 or .. 012 was used for adjusting (injection pump - engine timing), re-mount the lower tube onto the oil filter (illustration, arrow).



1 = Fuel-injection lines

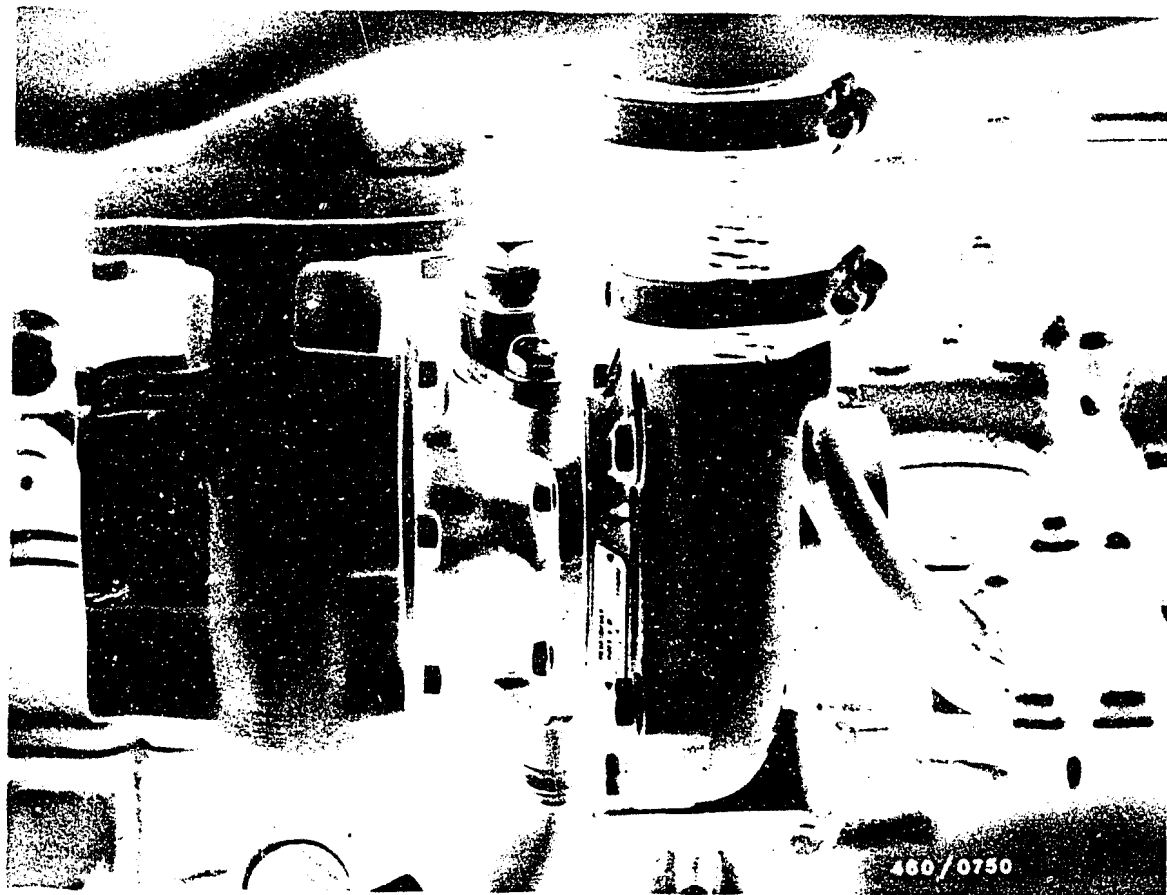
Tighten the fuel-injection lines using open box wrench KDEP 1115.
(Prevent the delivery-valve holders from turning by counterholding with a wrench.)

Align the support bracket on the hydraulic head of the injection pump so that it is up against the cylinder block and hydraulic head free of tension.

Screw down the support bracket.

If necessary, bleed the injection system.

Return to trouble-shooting chart B04



Measure the charge-air pressure

The charge-air pressure is measured on the chassis dynamometer.
For set value, see brief instructions.

Note:

To assess the exhaust-gas turbocharger, it is essential that the start of delivery and the nozzle-opening pressure are correctly set, that the intake and exhaust sides have no leaks, and that the engine is in good mechanical condition (valve clearance, compression).

TESTING THE CHARGE-AIR PRESSURE

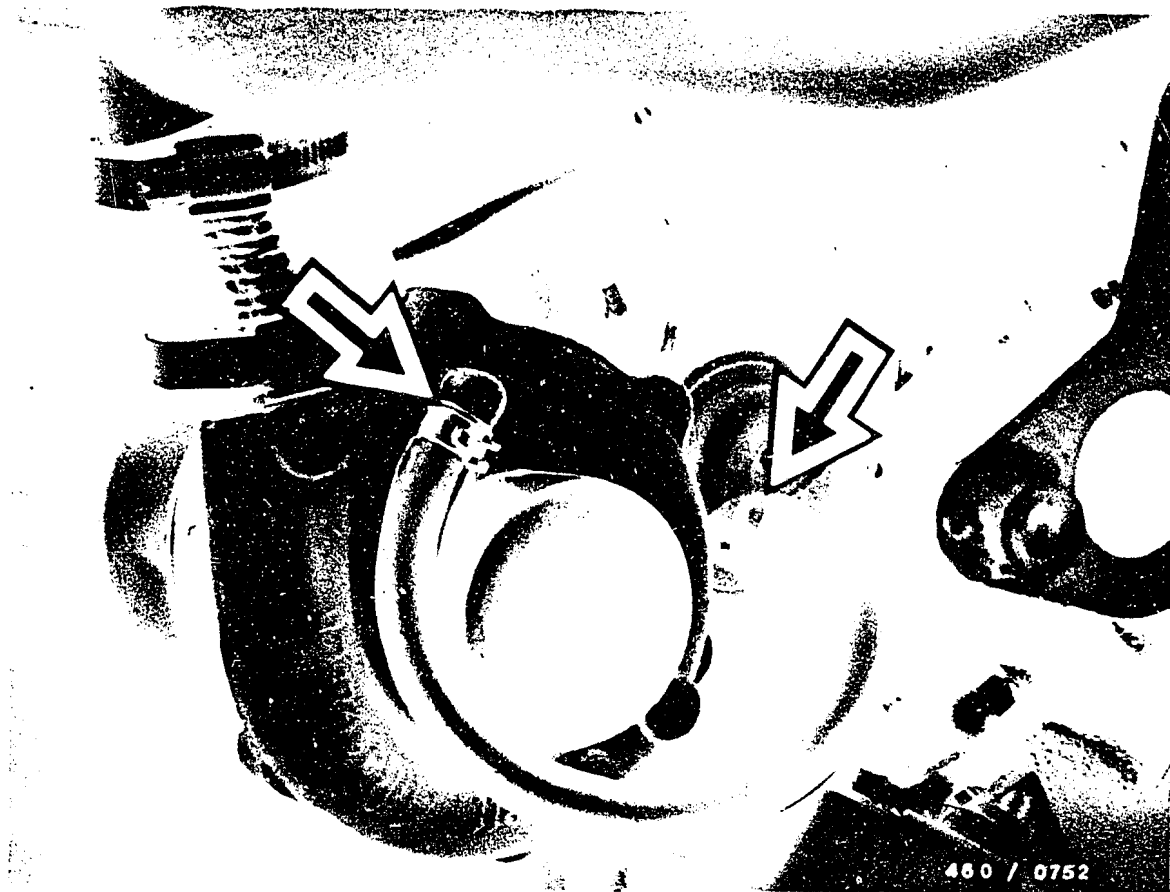
When working on the turbocharger, it should be noted that even the smallest particles of dirt can lead to the destruction of the turbocharger.

Therefore, n e v e r run the engine without the air filter.

For testing the charge-air pressure, it is possible to use pressure tester KDJE-P 100, or a pressure gauge 0...1.6 bar (e.g. Wika No. 4184).

Test instruction:

Connect the respective measuring tool to the charge-air tube fitting (near to vacuum pump - engine).

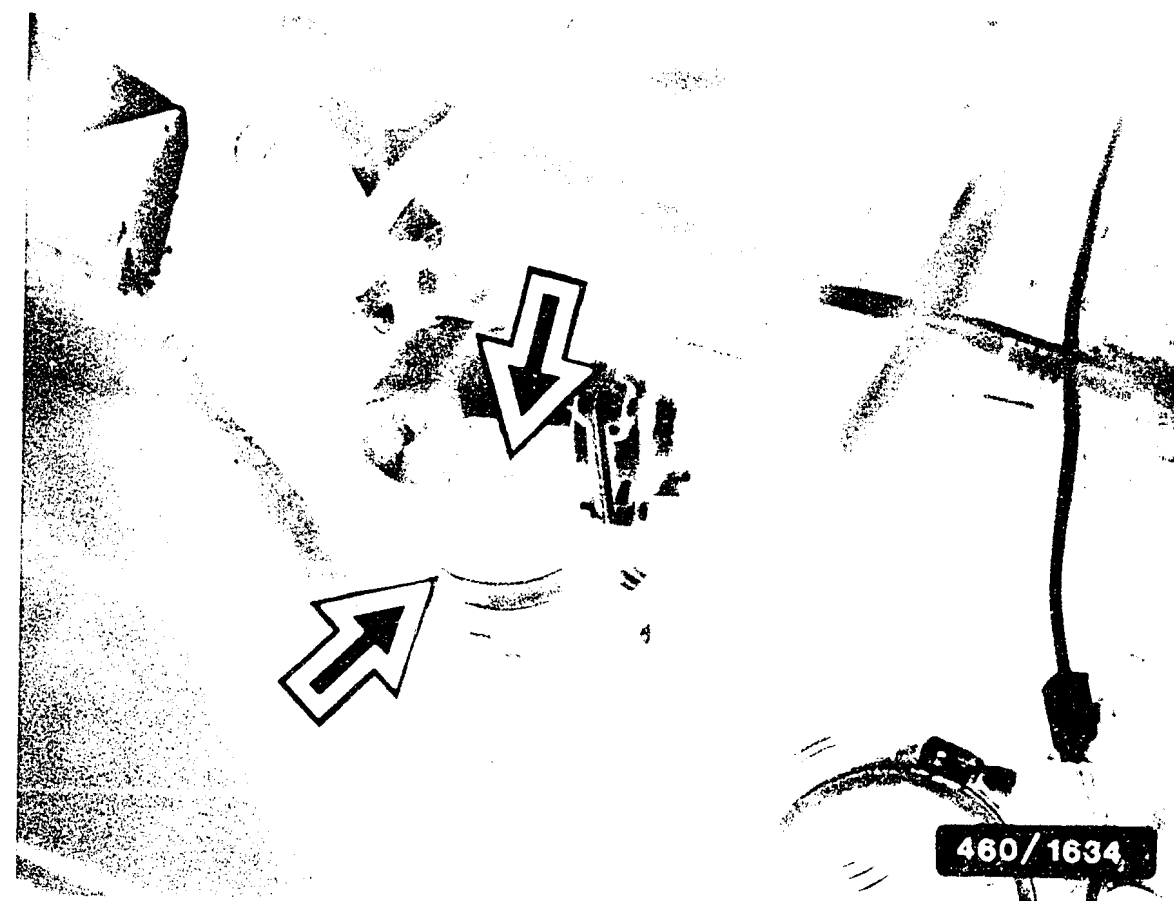


Charge-air pressure too high:

- * Line to wastegate loose or defective (illustration, arrows).
- * Diaphragm of wastegate defective (*).
- * Valve of wastegate seized, closed (*).
- * Valve of wastegate incorrectly set (*).
- * = replace exhaust-gas turbocharger.

Note:

After installing a new turbocharger, fill the turbocharger with oil and allow the engine to idle for approx. 1 minute so that there is a guaranteed supply of oil to the turbocharger.



Charge-air pressure too low:

- * Gasket between charge-air tube and engine block leaking.
- * Connecting hose between compressor outlet and throttle valve (see illustration - arrow) leaking.

Further causes of the charge-air pressure being too low:

- * Air filter (fouled).
- * Wastegate incorrectly set. *
- * Turbine shaft tending to seize. *
- * Exhaust system clogged.
- * = replace turbocharger.

Return to trouble-shooting chart B04

INDEX

Coordinate

Accelerator pedal	C07
Air-flow sensor	D05
Atmospheric-pressure sensor	D01
Control units	A14/E09
Delivery controller	C19
Electric shutoff device (ELAB)	G08
Exhaust-gas recirculation	F17
Fault lamp	B08
Fuel-injection pump	H26
Gear-shift valve	E25
Glow plugs	F20
Glow-duration control unit	F20
Injection nozzles	H04
Needle-movement sensor	D23
Pressure transducer	D13
-Exhaust-gas recirculation	D13
-Road-speed control	D25
Reversed-polarity protection relay	E22
Road-speed switch	
-On	F01
-Off	F09
-Reinstatement	F13
Rotational-angle potentiometer	C11
Solenoid-operated-valve start of injection	E01
Speed sensor	C23
Speed sensor	D17
Switch -Brake	F05
-Clutch	F05
Temperature sensor	
-Intake air	B27
-Fuel	C03
-Coolant	C01
Timing device	H15
Turbocharger	K23

For production reasons:
continued on the following
coordinate.

TABLE OF CONTENTS

Section	Coordinates
Using the microcard.....	A02
Special features.....	A03
Safety and precautionary measures.....	A07
Test equipment and tools.....	A08
Installation position of components.....	A11
General plan of closed-loop-control exhaust-gas recirculation (EGR).....	A21
System overview - EDC.....	A23
Diagram of fuel lines.....	A25
Trouble-shooting.....	B01
Trouble-shooting chart.....	B04
Self-diagnosis.....	B07
Self-diagnosis test table.....	B13
Trouble-shooting program -- EDC.....	B27
Testing the preheating system.....	F20
Testing the engine shutoff device.....	G08
Checking laying of fuel-injection tubing.....	G10
Checking the tank ventilation.....	G11
Bleeding the fuel system of air.....	G12
Replacing and draining water from the filter box...	G14
Testing the injection system for leaks.....	G17
Checking the fuel lines.....	G20
Smoke test - checking air filter.....	G21
Testing injection nozzles.....	H04
Testing fuel filter.....	H12
Testing timing device/solenoid-operated-valve start of injection.....	H15
Measuring engine compression and pressure loss.....	H16
Removing fuel-injection pump.....	H26
Installing fuel-injection pump.....	J02
Testing and adjusting engine timing.....	J20
Coordination, injection pump - engine (injection timing).....	K11
Testing charge-air pressure.....	K23
Index.....	N26

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